

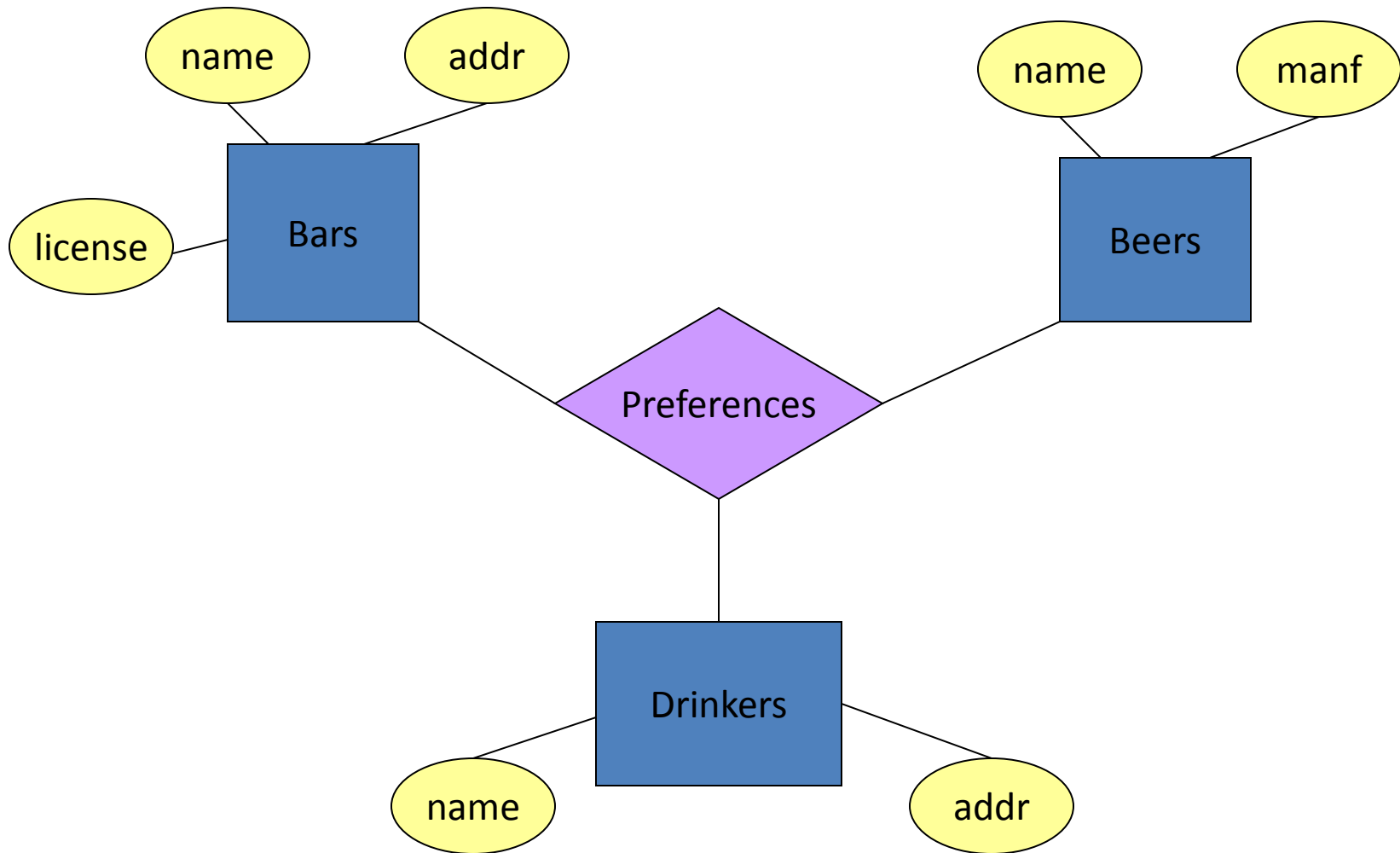
Entity-Relationship Model

1. Entity
2. Attributes
3. Entity Sets
4. Relationship Sets
5. Design Issues
6. Mapping Constraints
7. Weak Entity
8. Keys
9. E-R Diagram
10. Extended E-R Features
11. Design of an E-R Database Schema
12. Reduction of an E-R Schema to Tables

Multiway Relationships

- Sometimes, we need a relationship that connects more than two entity sets.
- Suppose that drinkers will only drink certain beers at certain bars.
 - Our three binary relationships **Likes**, **Sells**, and **Frequents** do not allow us to make this distinction.
 - But a 3-way relationship would.

Example: 3-Way Relationship



Weak Entity Sets

Occasionally, entities of an entity set need “help” to identify them uniquely.

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.

An entity set that does not possess sufficient attributes to form a primary key is called a **weak entity set**. One that does have a primary key is called a **strong entity set**.

For a weak entity set to be meaningful, it must be part of a one-to-many relationship set. This relationship set should have no descriptive attributes. (Why?)

The idea of strong and weak entity sets is related to the existence dependencies.

Member of a strong entity set is a dominant entity.

Member of a weak entity set is a subordinate entity.

A weak entity set does not have a primary key, but we need a means of distinguishing among the entities.

The **discriminator** of a weak entity set is a set of attributes that allows this distinction to be made.

The **primary key of a weak entity set** is formed by taking the primary key of the strong entity set on which its existence depends (see Mapping Constraints) plus its **discriminator**.

Example: Weak Entity Set

For example,

The entity set *transaction* has attributes *transaction-number*, *date* and *amount*.

Different transactions on different accounts could share the same number.

These are not sufficient to form a primary key (uniquely identify a transaction).

Thus *transaction* is a weak entity set.

Example: Weak Entity Set

To illustrate:

transaction is a weak entity. It is existence-dependent on *account*.

The primary key of *account* is *account-number*.

transaction-number distinguishes transaction entities within the same account (and is thus the discriminator).

So the primary key for *transaction* would be (*account-number*, *transaction-number*).

Example: Weak Entity Set

- **name** is almost a key for football players, but there might be two with the same name.
- **number** is certainly not a key, since players on two teams could have the same number.
- But **number**, together with the team **name** related to the player by **Plays-on** should be unique.

Conclusion....

- An entity set that does not have a primary key is referred to as a *weak entity set*.
- **Just Remember:** The primary key of a weak entity is found by taking the primary key of the strong entity on which it is existence-dependent, plus the discriminator of the weak entity set.
- The existence of a weak entity set depends on the existence of a *identifying entity set*
 - it must relate to the identifying entity set via a total, one-to-many relationship set from the identifying to the weak entity set
 - *Identifying relationship* depicted using a double diamond

Weak Entity Sets (Cont.)

- Note: the primary key of the strong entity set is not explicitly stored with the weak entity set, since it is implicit in the identifying relationship.
- If *loan-number* were explicitly stored, *payment* could be made a strong entity, but then the relationship between *payment* and *loan* would be duplicated by an implicit relationship defined by the attribute *loan-number* common to *payment* and *loan*

Representing Weak Entity Sets

- A weak entity set becomes a table that includes a column for the primary key of the identifying strong entity set

<i>loan-number</i>	<i>payment-number</i>	<i>payment-date</i>	<i>payment-amount</i>
L-11	53	7 June 2001	125
L-14	69	28 May 2001	500
L-15	22	23 May 2001	300
L-16	58	18 June 2001	135
L-17	5	10 May 2001	50
L-17	6	7 June 2001	50
L-17	7	17 June 2001	100
L-23	11	17 May 2001	75
L-93	103	3 June 2001	900
L-93	104	13 June 2001	200

More Weak Entity Set Examples

- In a university, a *course* is a strong entity and a *course-offering* can be modeled as a weak entity
- The discriminator of *course-offering* would be *semester* (including year) and *section-number* (if there is more than one section)
- If we model *course-offering* as a strong entity we would model *course-number* as an attribute.

Then the relationship with *course* would be implicit in the *course-number* attribute

Weak Entity-Set Rules

- A weak entity set has one or more many-one relationships to other (supporting) entity sets.
 - Not every many-one relationship from a weak entity set need be supporting.
 - But supporting relationships must have a rounded arrow (entity at the “one” end is guaranteed).

Weak Entity-Set Rules – (2)

- The key for a weak entity set is its own underlined attributes and the keys for the supporting entity sets.
 - E.g., (player) **number** and (team) **name** is a key for **Players** in the previous example.

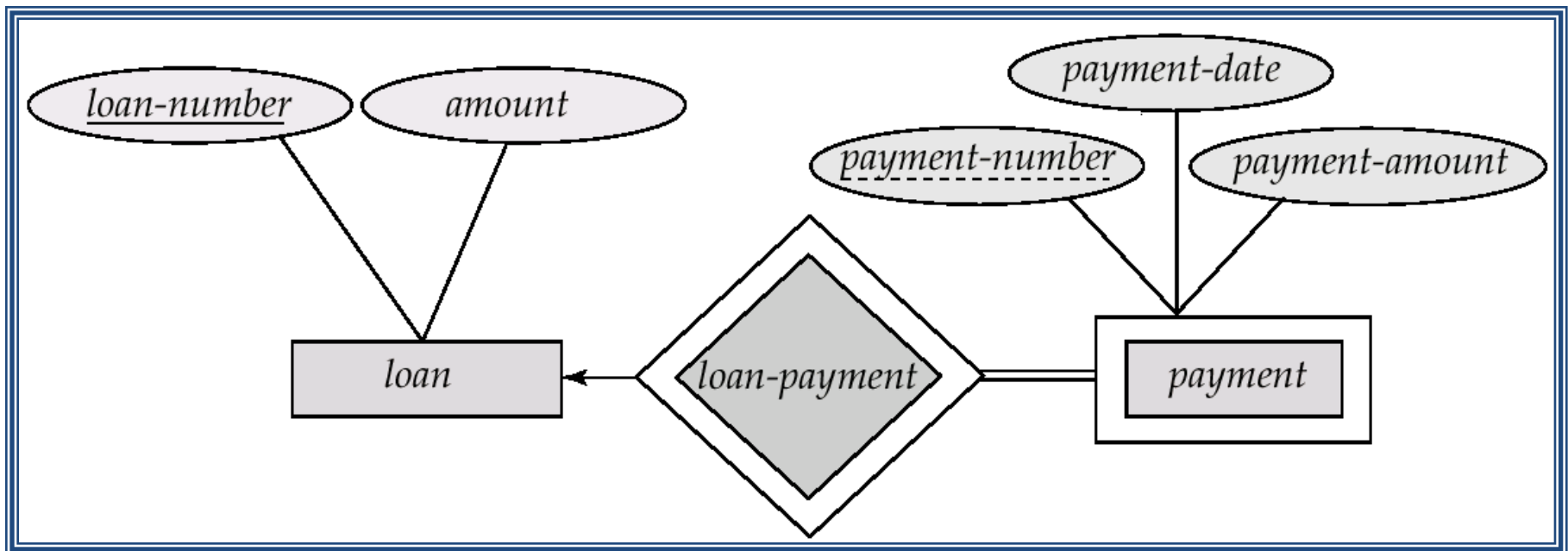
Solving the problem of Weak Entity

The *discriminator* (or *partial key*) of a weak entity set is the set of attributes that distinguishes among all the entities of a weak entity set.

The primary key of a weak entity set is formed by the primary key of the strong entity set on which the weak entity set is existence dependent, plus the weak entity set's discriminator.

Weak Entity Sets (Cont.)

- We depict a weak entity set by double rectangles.
- We underline the discriminator of a weak entity set with a dashed line.
- *payment-number* – discriminator of the *payment* entity set
- Primary key for *payment* – (*loan-number*, *payment-number*)



Don't Overuse Weak Entity Sets

- Beginning database designers often doubt that anything could be a key by itself.
 - They make all entity sets weak, supported by all other entity sets to which they are linked.
- In reality, we usually create unique ID's for entity sets.
 - Examples include social-security numbers, automobile VIN's etc.

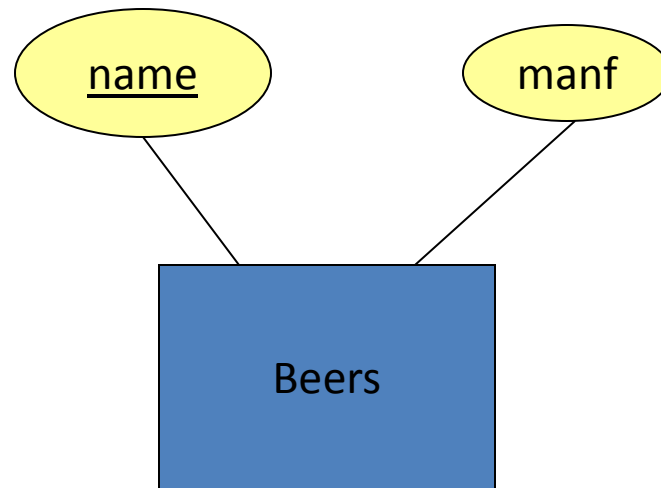
When Do We Need Weak Entity Sets?

- The usual reason is that there is no global authority capable of creating unique ID's.
- **Example:** it is unlikely that there could be an agreement to assign unique player numbers across all football teams in the world.

From E/R Diagrams to Relations

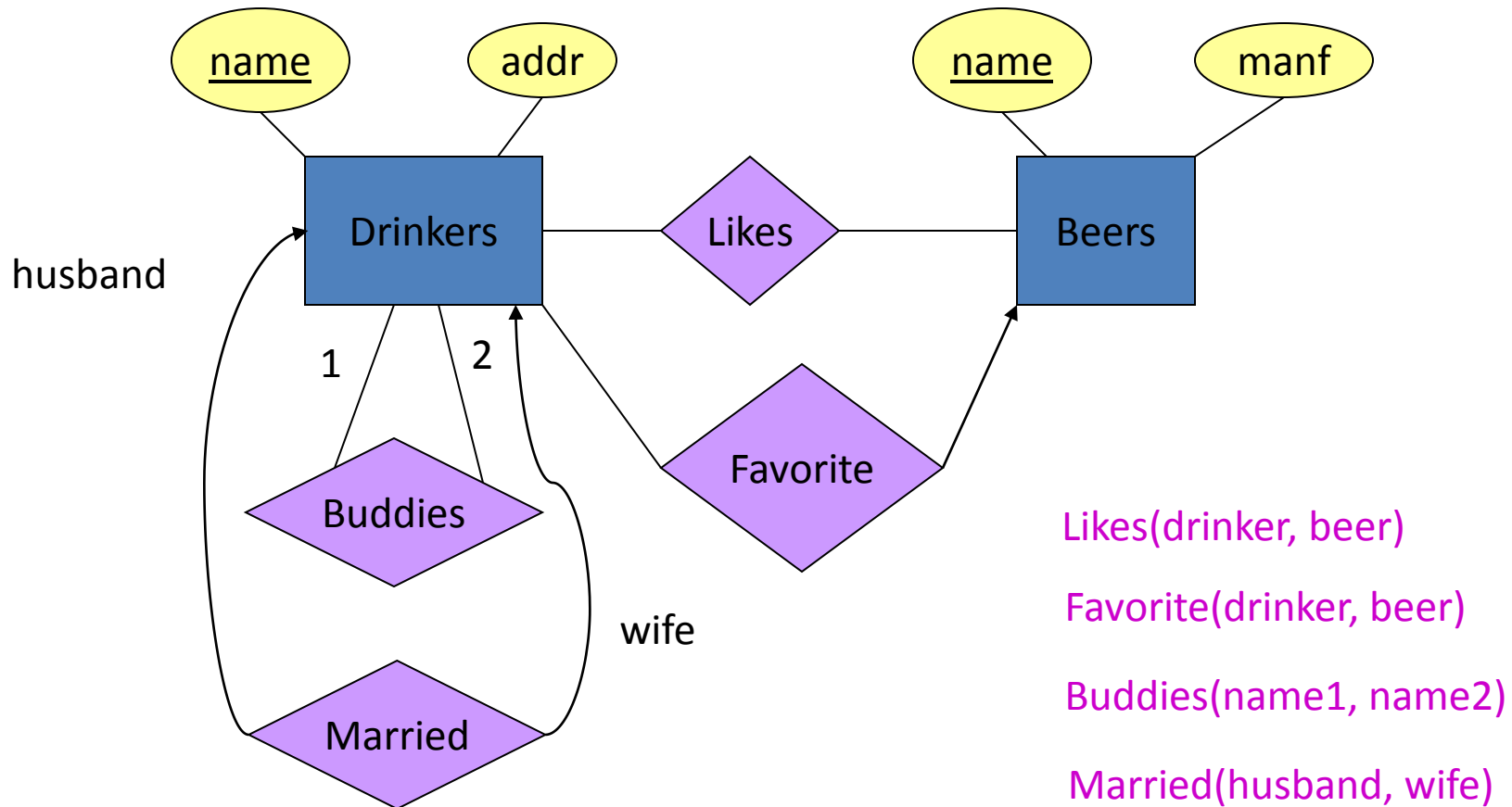
- Entity set \rightarrow relation.
 - Attributes \rightarrow attributes.
- Relationships \rightarrow relations whose attributes are only:
 - The keys of the connected entity sets.
 - Attributes of the relationship itself.

Entity Set -> Relation



Relation: **Beers(name, manf)**

Relationship -> Relation



Combining Relations

- OK to combine into one relation:
 1. The relation for an entity-set E
 2. The relations for many-one relationships of which E is the “many.”
- **Example:** Drinkers(name, addr) and Favorite(drinker, beer) combine to make Drinker1(name, addr, favBeer).

Risk with Many-Many Relationships

- Combining Drinkers with Likes would be a mistake. It leads to redundancy, as:

name	addr	beer
Sally	123 Maple	Bud
Sally	123 Maple	Miller

Redundancy

Handling Weak Entity Sets

- Relation for a weak entity set must include attributes for its complete key (including those belonging to other entity sets), as well as its own, nonkey attributes.
- A supporting relationship is redundant and yields no relation (unless *it* has attributes).