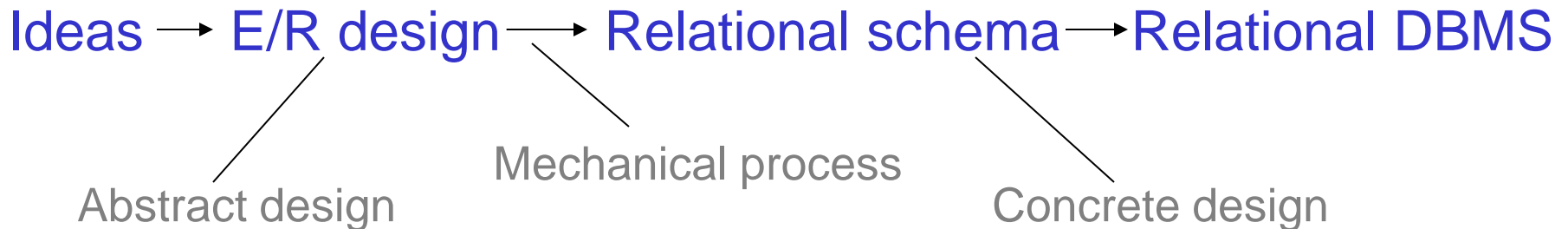


Entity-Relationship Model

Database Design

- Designing a database:
 - what information the database must hold, and
 - what relationships are there among components of that information.
- Notation for expressing designs: Entity-Relationship (E/R) model



Elements of the E/R Model

Entity sets



Movies

Attributes



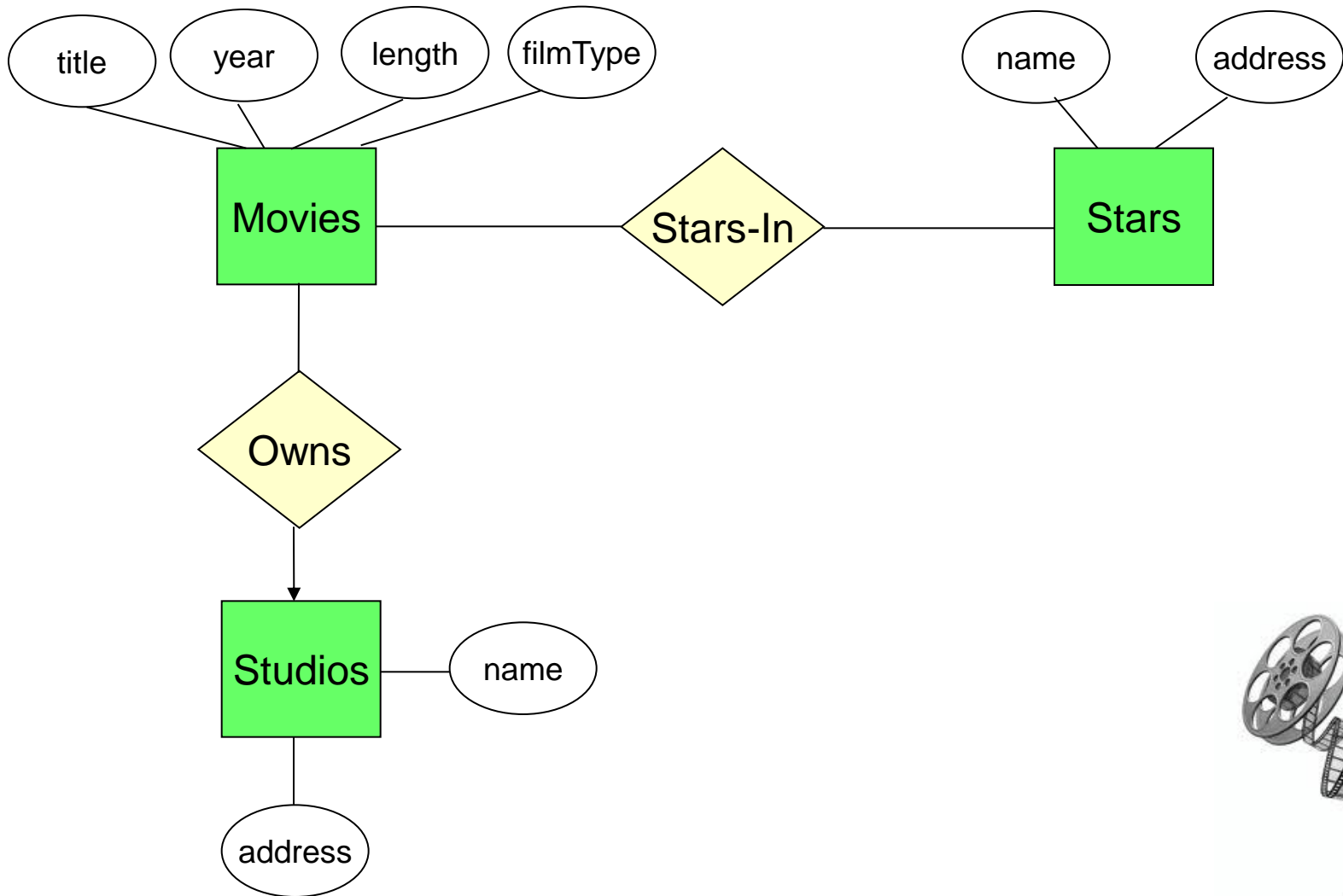
Title

Relationships



Stars-in

Example



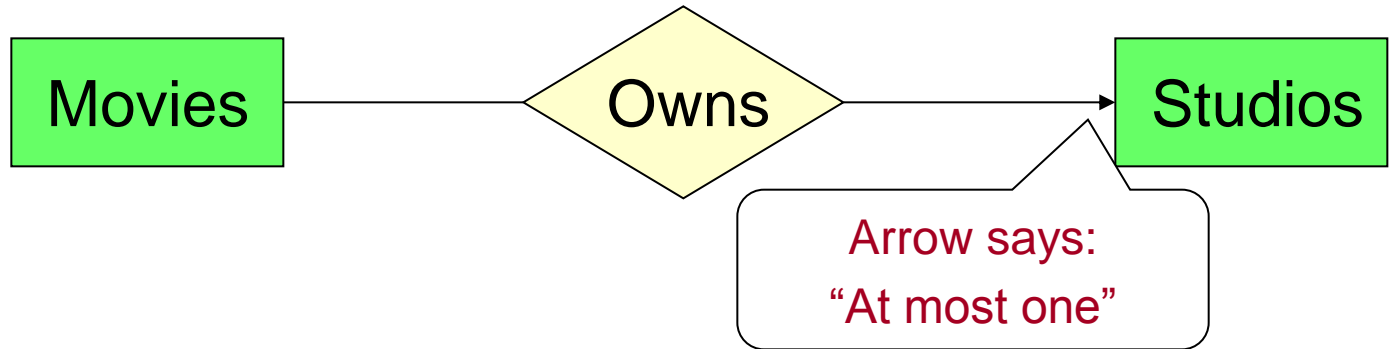
Visualizing Binary E/R Relationships

They are just sets of pairs

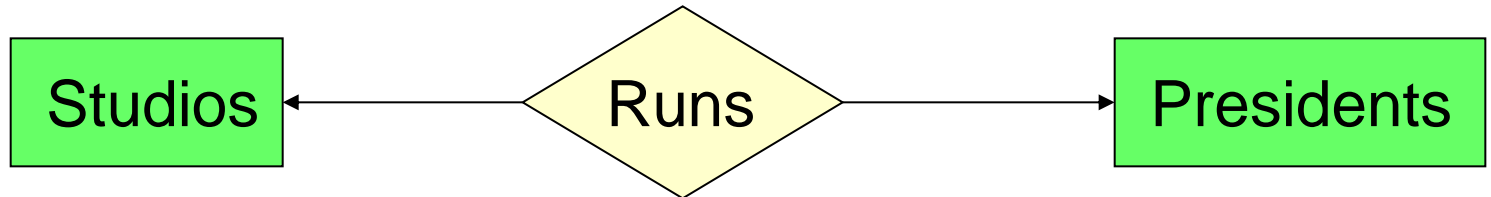
<u>Movies</u>		<u>Stars</u>
Basic Instinct		Sharon Stone.
Total Recall		Arnold Schwarzenegger.
Total Recall		Sharon Stone.

Multiplicity of Relationships

many-one



one-one

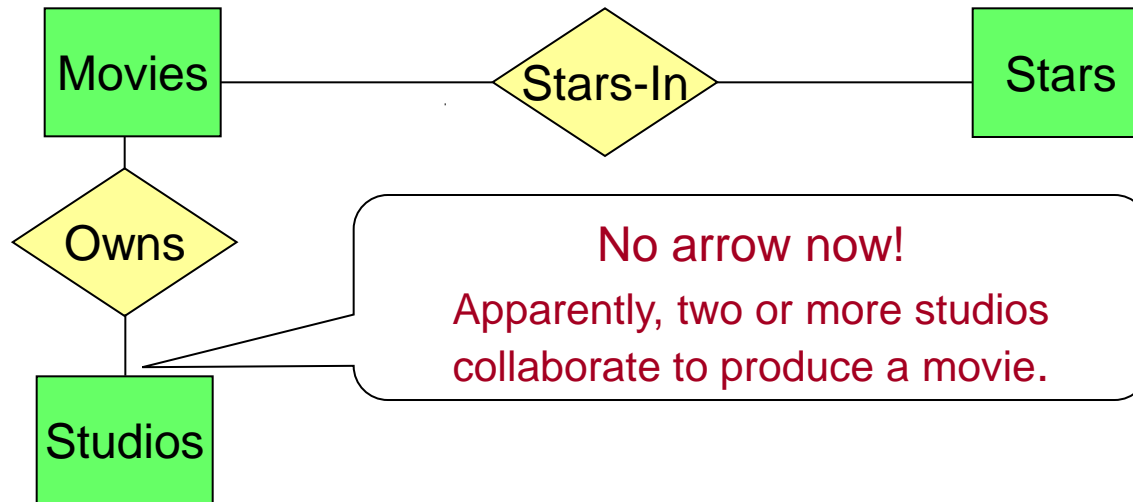


many-many



Sometimes binary relationships aren't enough!

Example



What could go wrong with this design?

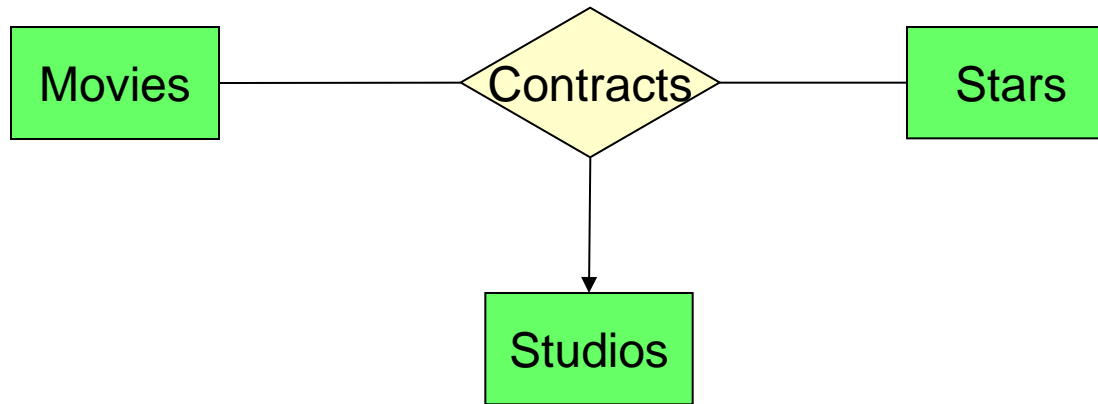
Which stars a studio is paying for a given movie?

Why some **studio-movie-star** triples can be invalid?

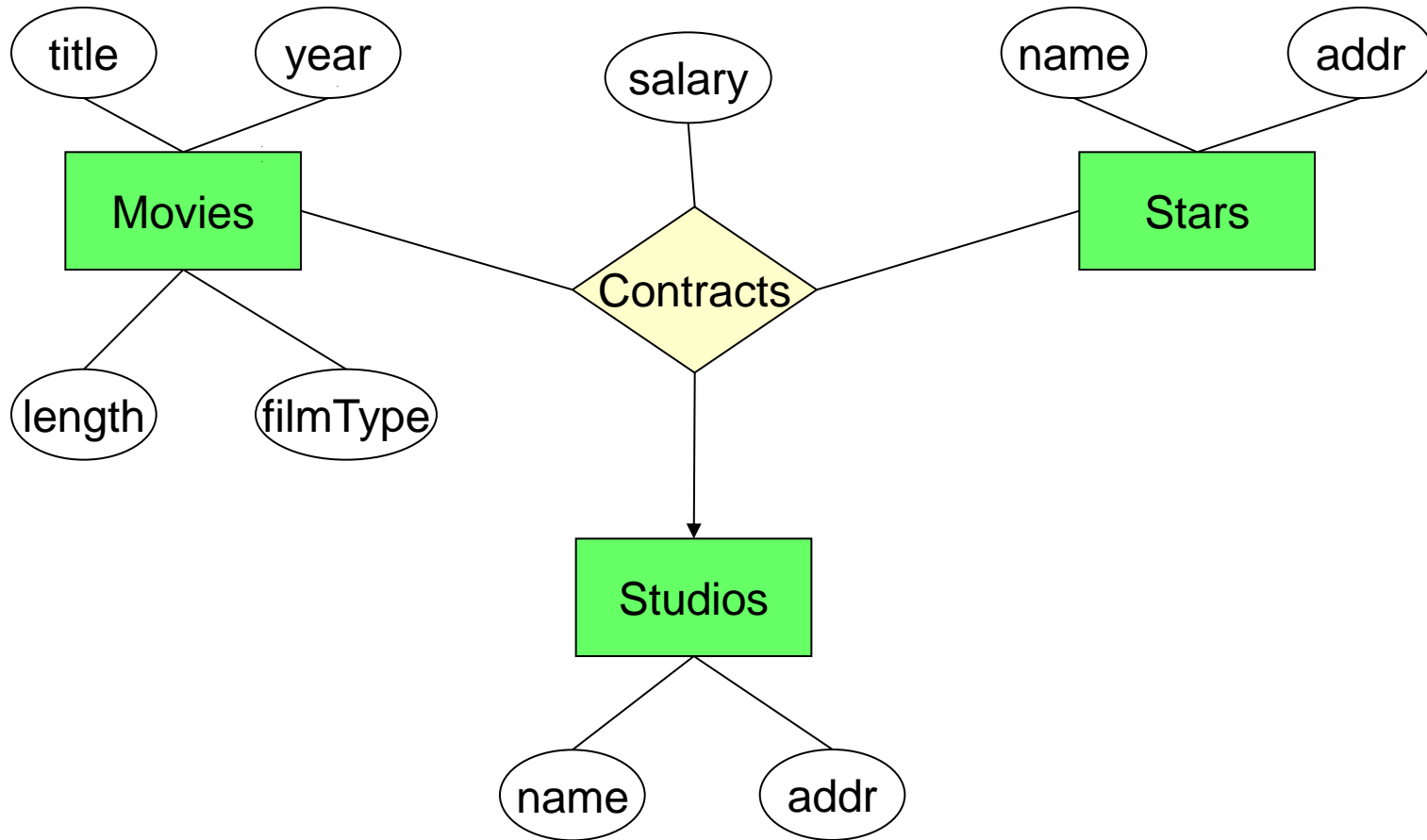
E.g.

- Carolco Pictures paid Arnold S. for movie Total Recall
and
TriStar paid Sharon S. for the same movie Total Recall.
- Using “Owns” and “Stars-In” we will have the following triples:
(CP, TR, AS) **(CP, TR, SS)** **(TS, TR, AS)** (TS, TR, SS)
- The **second** and the **third** triples aren't valid.
- If we consider the collection of all the valid triples, it is nothing else but a **three way relationship** between **Studios**, **Movies** and **Stars**

Solution: Three-way relationship

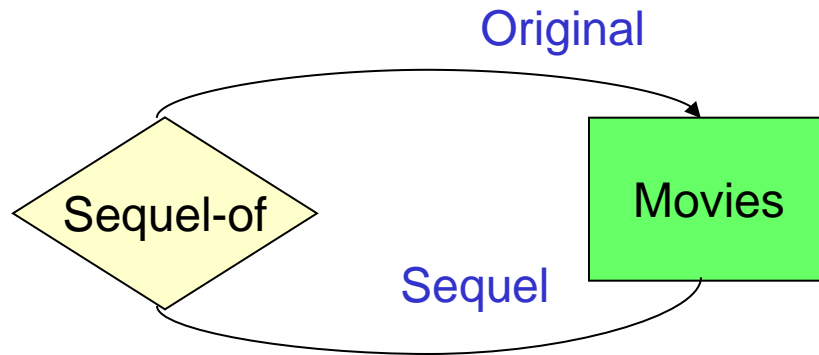


Attributes on Relationships



Roles in a relationship

- An entity set can appear two or more times in a relationship.
- Each line to the entity set represents a different **role**.



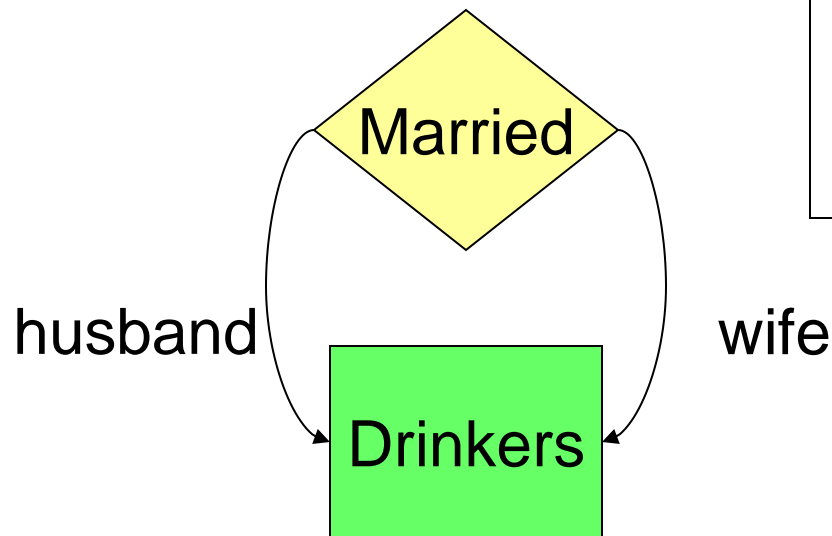
- A movie may have **many sequels**, but for each sequel there is **only one original movie**.



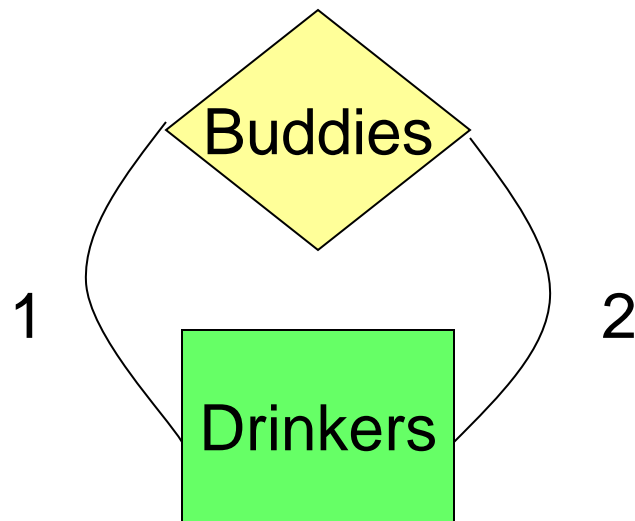
Another Example

Relationship Set

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



Another Example



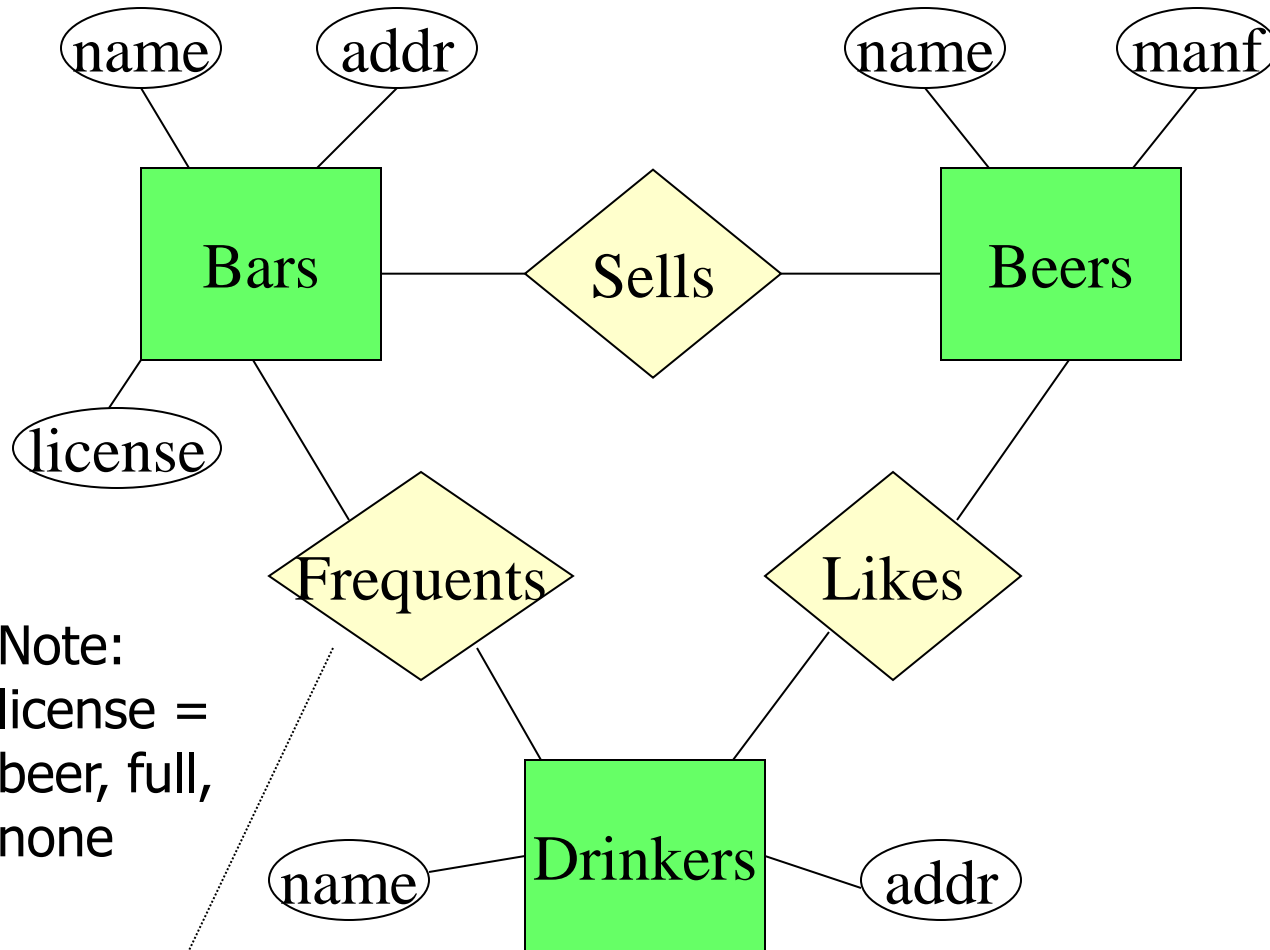
Relationship Set

Buddy1	Buddy2
Bob	Ann
Joe	Sue
Ann	Bob
Joe	Moe
...	...

“Bars-Beer-Drinkers” (BBD) Example

- Bars sell some beers.
- Drinkers like some beers.
- Drinkers frequent some bars.
- What would the E/R diagram be?

"Bars-Beer-Drinkers" (BBD) Example



Bars sell some beers.

Drinkers like some beers.

Drinkers frequent some bars.

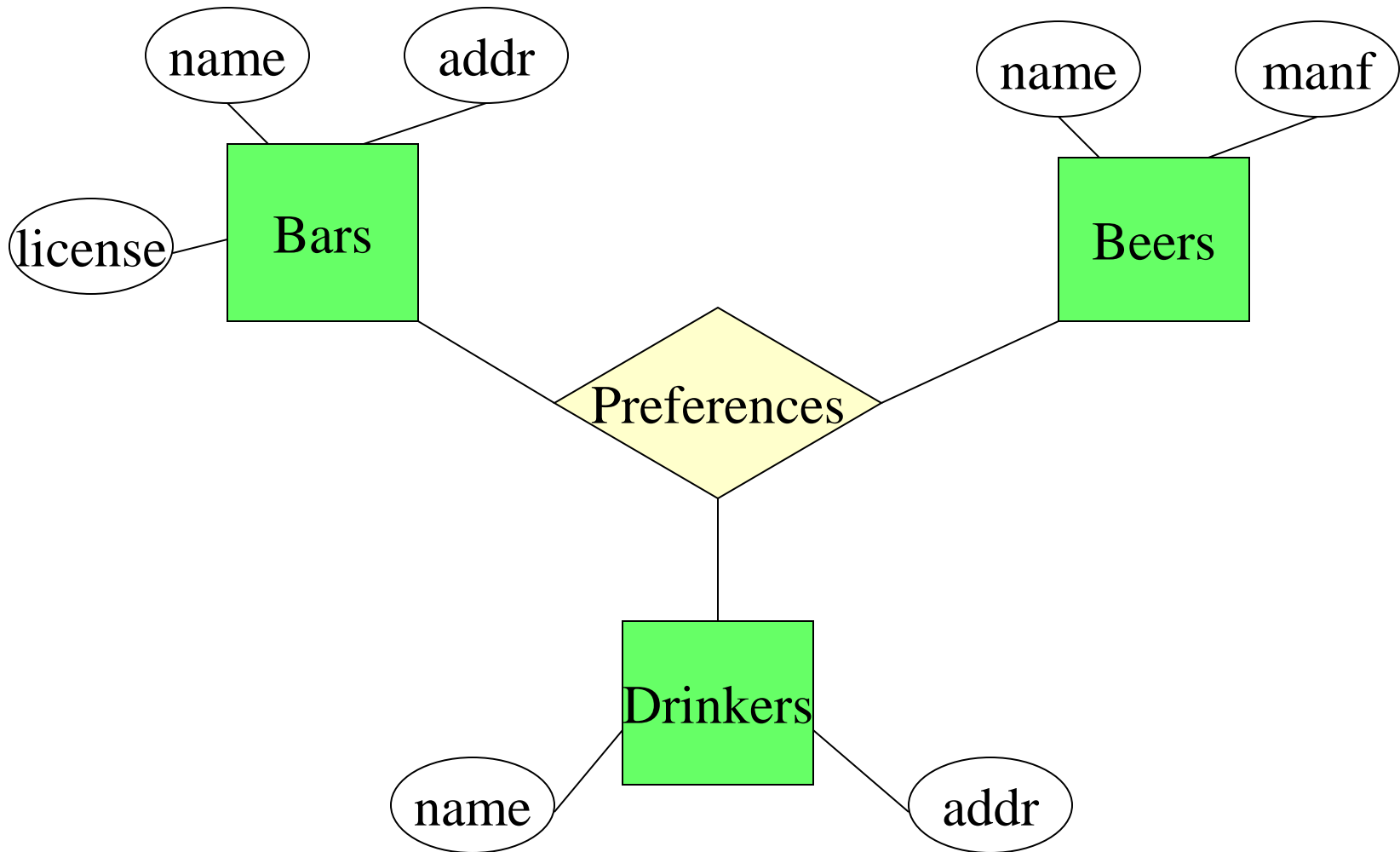
Note:
license =
beer, full,
none

Why we need it?

BBD Multiway Relationship

- Suppose that drinkers will only drink certain beers at certain bars.

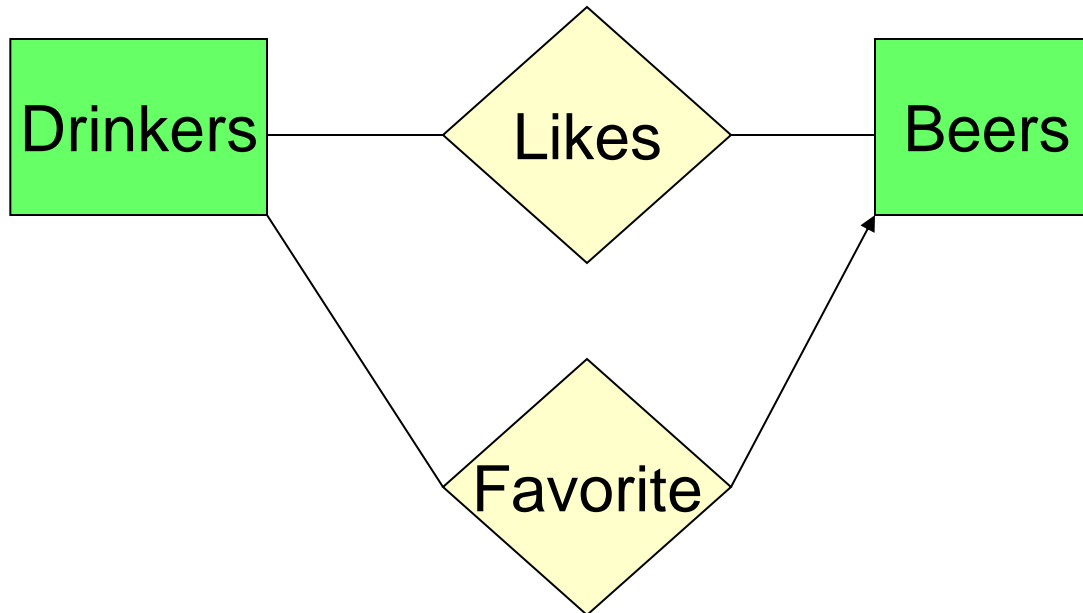
BBD Multiway Relationship



A Typical Relationship Set

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

Multiple Relationships Between Two Entity Sets



“Exactly one” Multiplicity



Some beers are not the best-seller of any manufacturer, so a **rounded arrow** to *Manfs* would be inappropriate.

But a manufacturer has to have a best-seller.

Exercise 1

- Let us design a database for a bank, including information about customers and their accounts. Information about a customer includes their name, address, phone, and SIN number. Accounts have numbers, types (e.g., savings, checking) and balances. We also need to record the customer(s) who own an account. Draw the E/R diagram for this database.
- Modify your solution as follows:
 - a) Change your diagram so an account can have only one customer.
 - b) Change your diagram so that a customer can have a set of addresses (which are street-city-province triples) and a set of phones. Remember that we do not allow attributes to have nonatomic types, such as sets, in the E/R model.
 - c) Further modify your diagram so that customers can have a set of addresses, and at each address there is a set of phones.

Exercise 2

- Give an E/R diagram for a database recording information about teams, players, and their fans, including:
 1. For each team, its name, its players, its team captain (one of its players), and the colors of its uniform.
 2. For each player, his/her name.
 3. For each fan, his/her name, favorite teams, favorite players, and favorite color.
- Suppose we wish to add to the schema a relationship “Led-by” among two players and a team. The intention is that this relationship set consists of triples (player1, player2, team) such that player 1 played on the team at a time when some other player 2 was the team captain.

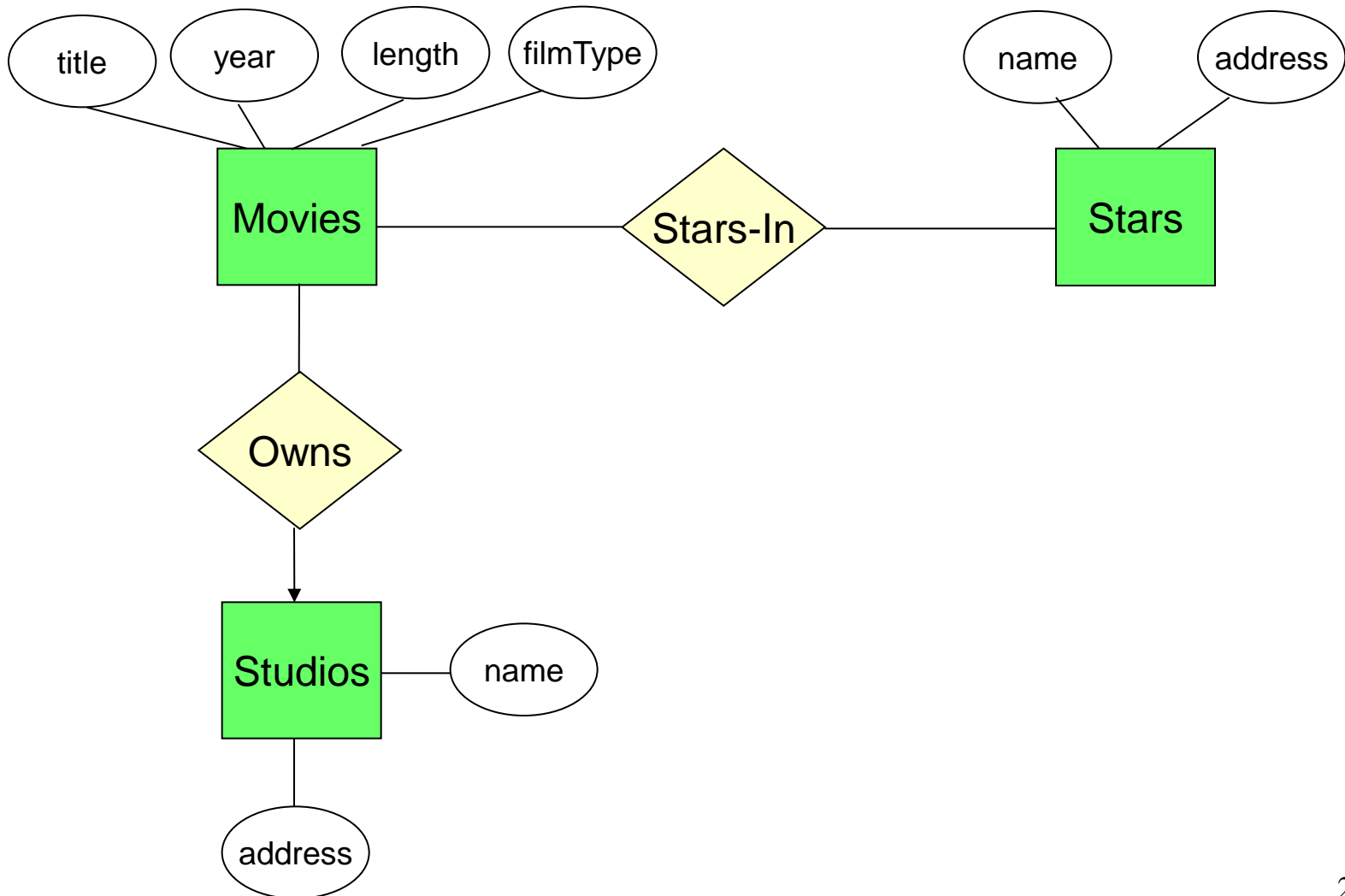
Draw the modification to the E/R diagram.

Keys

- A *key* (for an entity set) is a set of attributes such that no two entities are the same on all the attributes of the key.
- In E/R, we underline the key attribute(s).



Keys?



Key for Movies

- Let's consider the entity set **Movie**.
- We might assume that the attribute **title** is a key. However, there can be different movies with the same name:
 - “Godzilla” has several different versions (Japanese, American etc.).
- If we **enforce** in the database a **key constraint** on attribute **title** of **Movie** class, then the **DBMS** will not allow us to insert information about different “Godzilla’s”.
- A better choice is to take the set **{title, year}** of attributes as a key.
 - We still run the risk that there are two movies made in the same year, with the same title, but that's very unlikely.

Keys for Studios and Stars

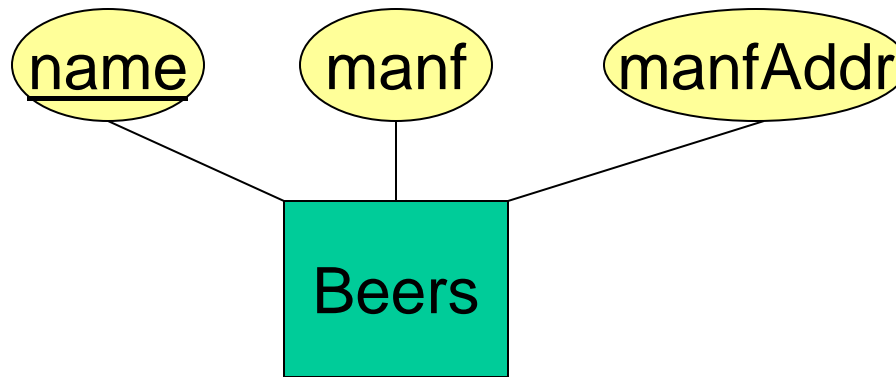
- For **Studios**:
 - Reasonable to assume that there are **no** two studios having the **same name**.
 - So, we will enforce **name** to serve as a **key**.
- For **Stars**:
 - We may think that the name can't serve to distinguish two people, but...
 - Yes! For stars the name distinguishes them since traditionally they choose "stage names".
 - So, again here, we will enforce **name** to serve as a **key**.

Surrogate Keys

- Often, people introduce attributes whose role is to serve as a key for classes.
 - Companies assign employee ID's to all employees, and these ID's are carefully chosen to be unique numbers.
 - In Canada everyone has a SIN.
 - Students ID's in universities
 - Driver's license numbers
 - Automobile registration numbers

Entity Sets Versus Attributes I

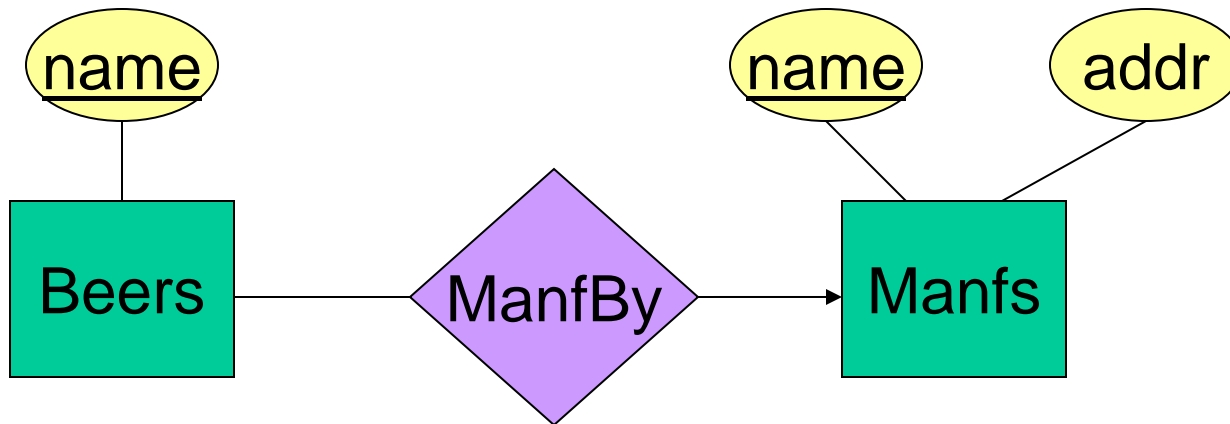
- Example: Bad design



1. Repeats the manufacturer's address once for each beer;
2. Loses the address if there are temporarily no beers for a manufacturer.

Entity Sets Versus Attributes II

- 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 nonkey attribute.or
 - It is the “many” in a many-one or many-many relationship.
- Example: Good

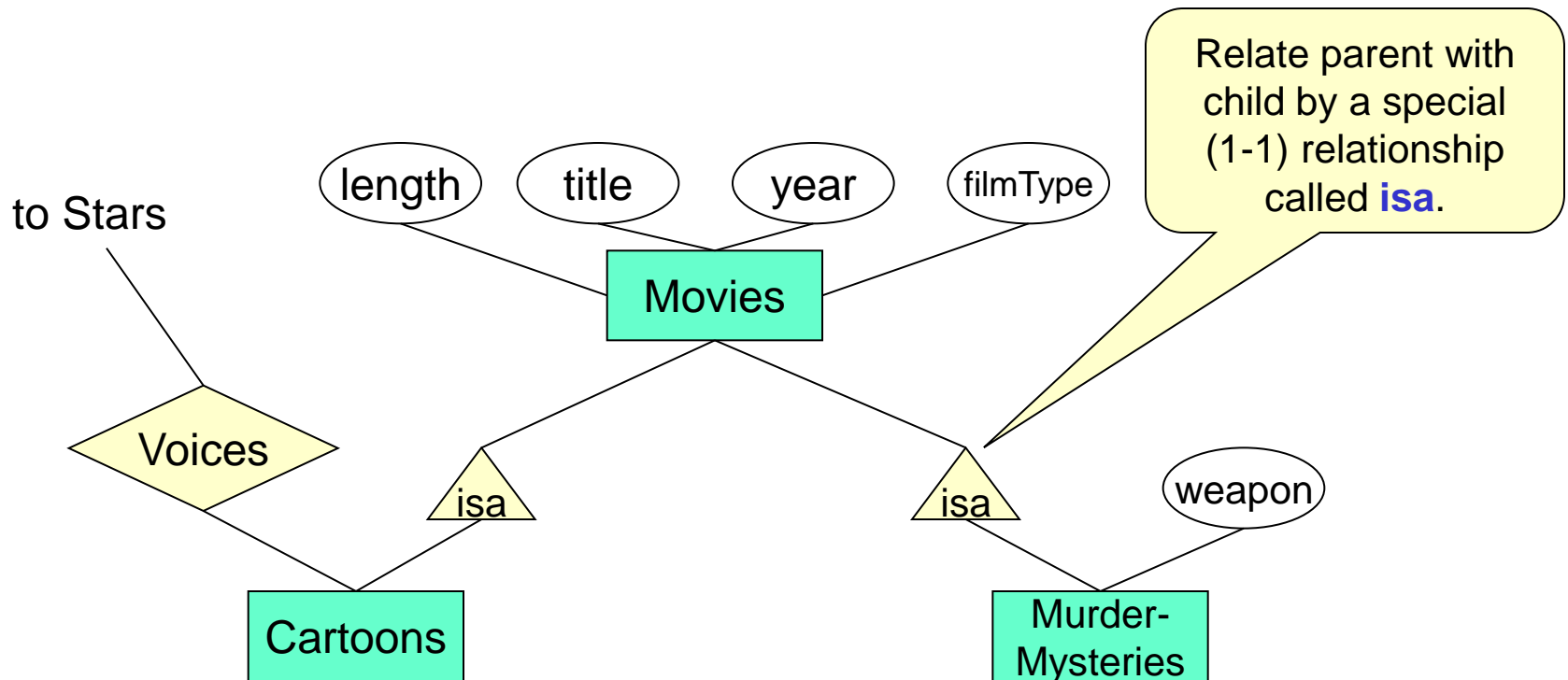


Manfs deserves to be an entity set because of the nonkey attribute *addr*.

Beers deserves to be an entity set because it is the “many” of the many-one relationship *ManfBy*.

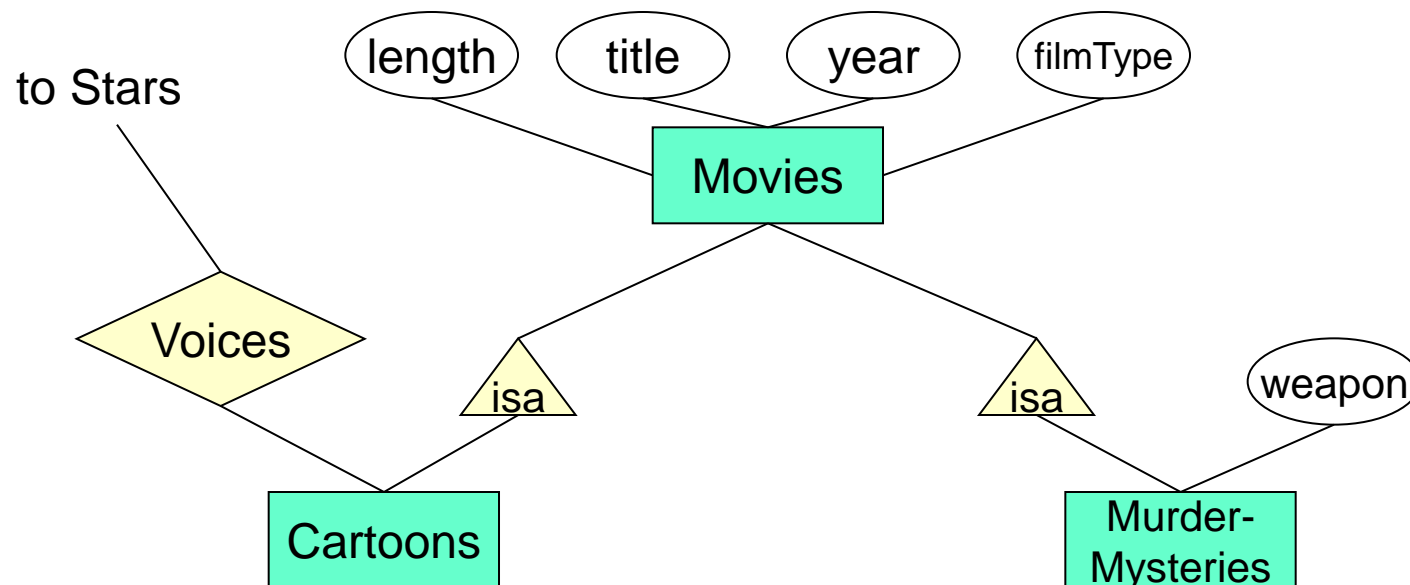
Subclasses

- Sometimes, a class (entity set) contains certain objects (entities) that have special properties not associated with all members of the class.



Inheritance in the E/R Model

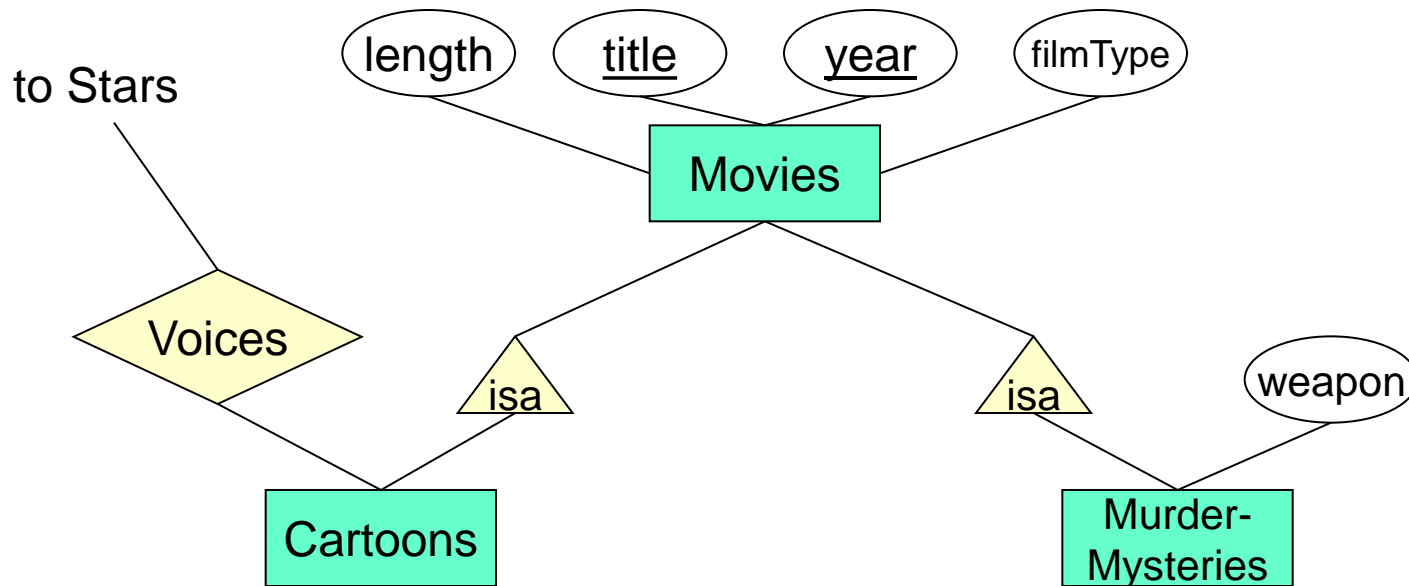
- E/R entities have components in all subclasses to which they belong.
- **Example: Roger Rabbit**, which is both a **cartoon** and **murder-mystery**
 - will have components in all three entity sets: **Movies**, **Cartoons**, **Murder-Mysteries**.
 - i.e. it will have all four attributes of **Movies**, the attribute **weapon**, and finally will participate in the relationship **voices**.



Keys for entity set hierarchies

Key of root is key for all.

E.g. {**title**,**year**} is the key for **Movies**, **Cartoons** and **Murder-Mysteries**.



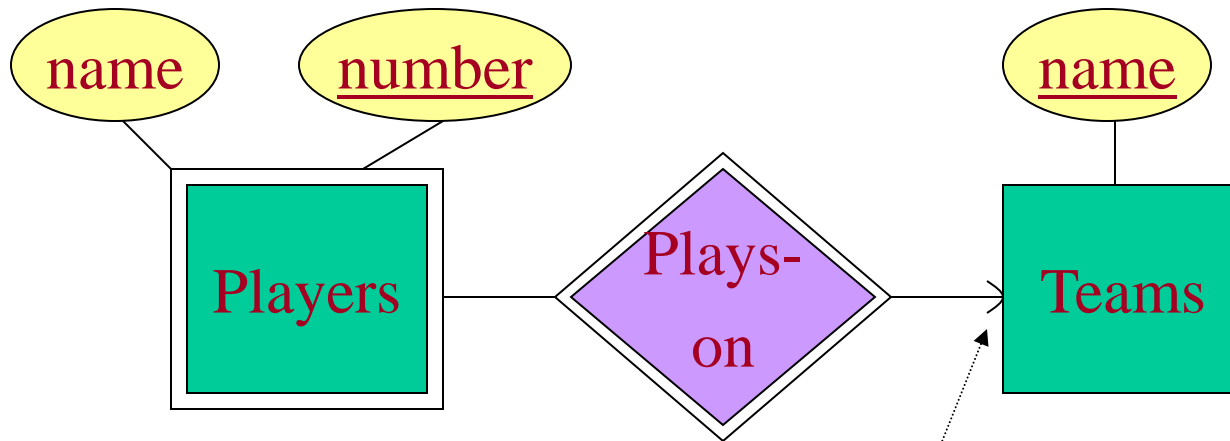
Weak Entity Sets

- 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.

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.

In E/R Diagrams



Note: must be rounded
because each player needs
a team to help with the key.

- Double diamond for **supporting** many-one relationship.
- Double rectangle for the weak entity set.

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).
- 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.