CZ2007 Introduction to Database Systems (Week 1)

Topic 1: Entity Relationship Diagram (2)

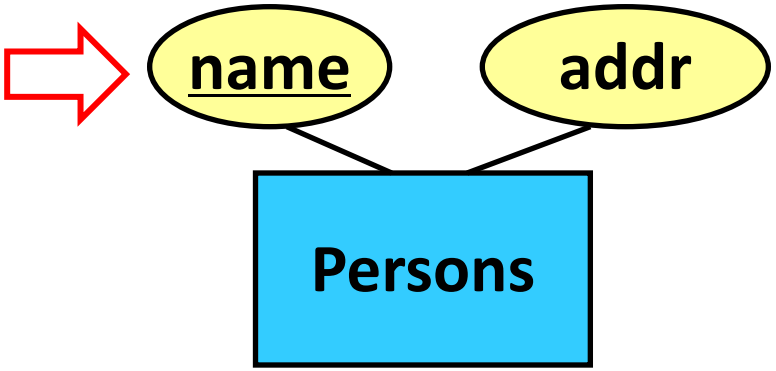
This Lecture

- Constraints
- Subclasses
- Weak Entity Sets

Constraints

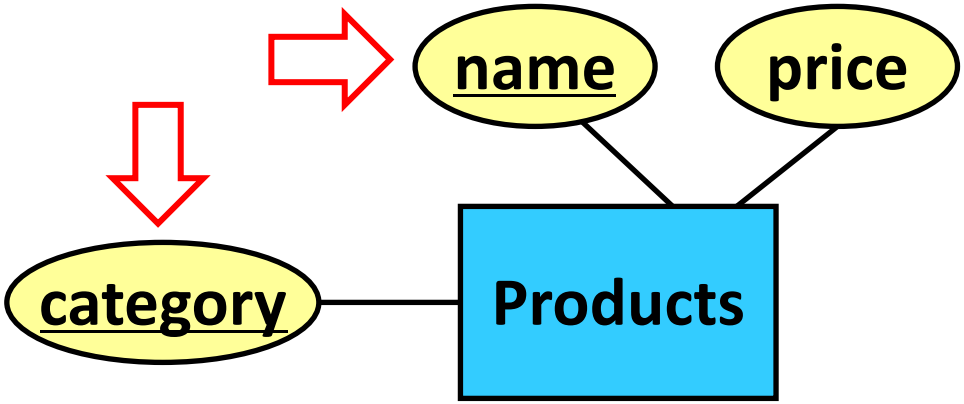
- Some conditions that entity sets and relationships should satisfy
- We will focus on three types of constraints
  - Key constraints ✓
  - Referential integrity constraints ✓
  - Degree constraints ✓

Key



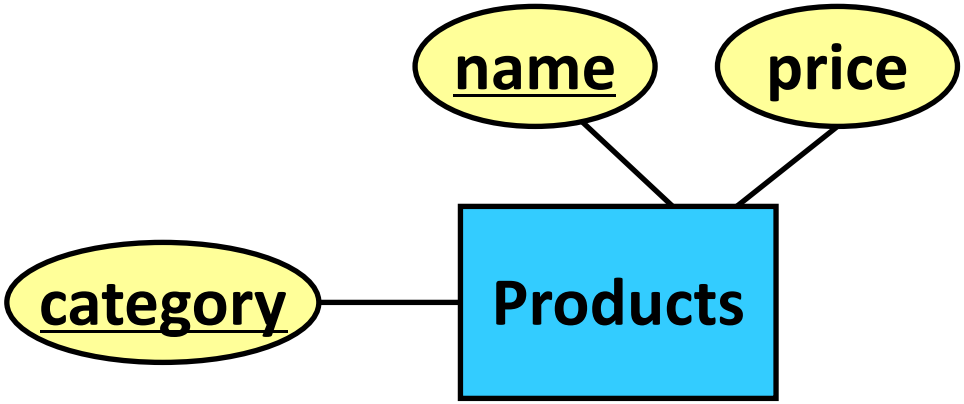
- One or more attributes that are underlined
- Meaning: They uniquely represent each entity in the entity set
- Example: The “name” uniquely represents each and every person
- i.e., each person must have a unique name

Key



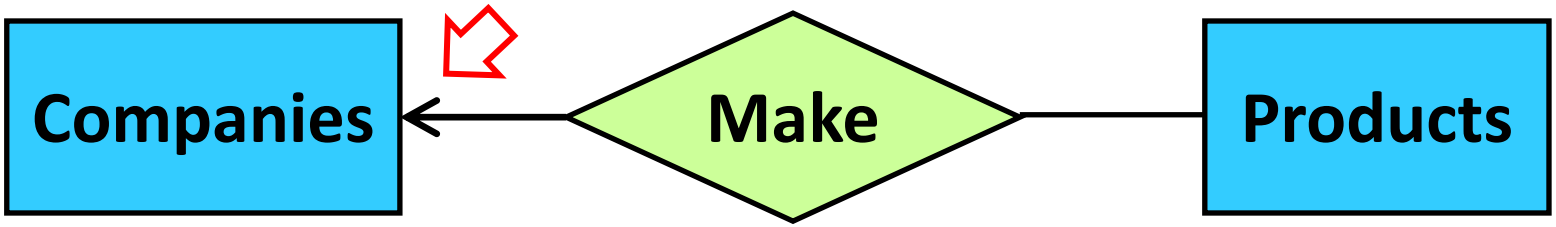
- One or more attributes that are underlined
- Each product has a unique <name, category> combination
- But there can be products with the same name, or the same category, but not both
- Example
  - Name = “Apple”, Category = “Fruit”, Price = “1”
  - Name = “Apple”, Category = “Phone”, Price = “888”

Key



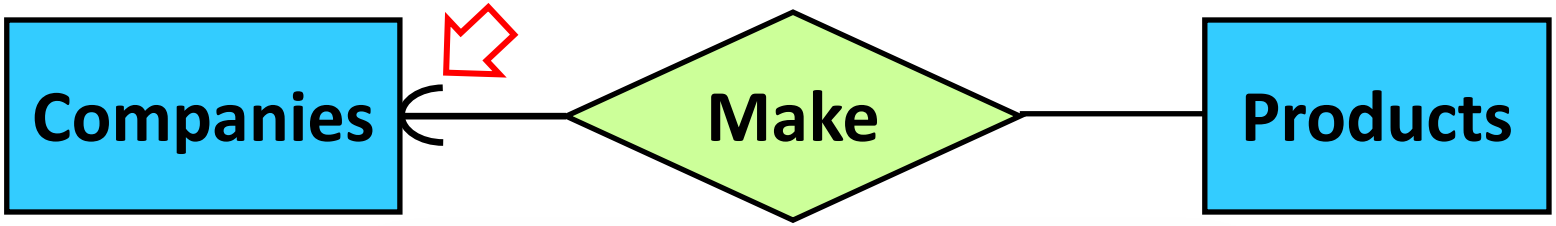
- Rule: Every entity set should have a key
  - So that we can uniquely refer to each entity in the entity set

Referential Integrity



- One company may make multiple products
- One product is made by one company
- Can there be a product that is not made by any company?
- No.
- i.e., every product must be involved in the Make relationship
- This is called a referential integrity constraint.
- How do we specify this in an ER diagram?
- Use a rounded arrow instead of a pointed arrow

Referential Integrity



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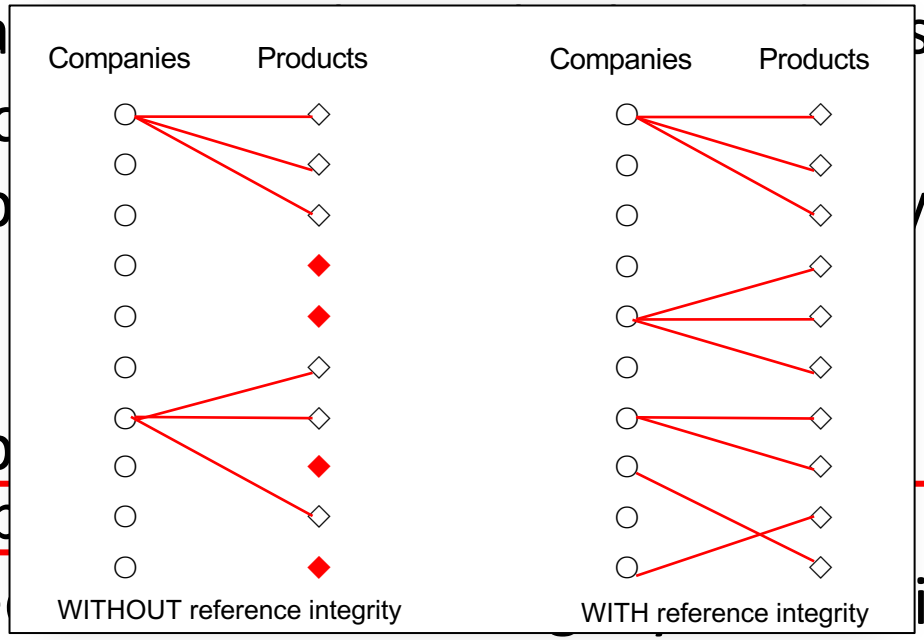

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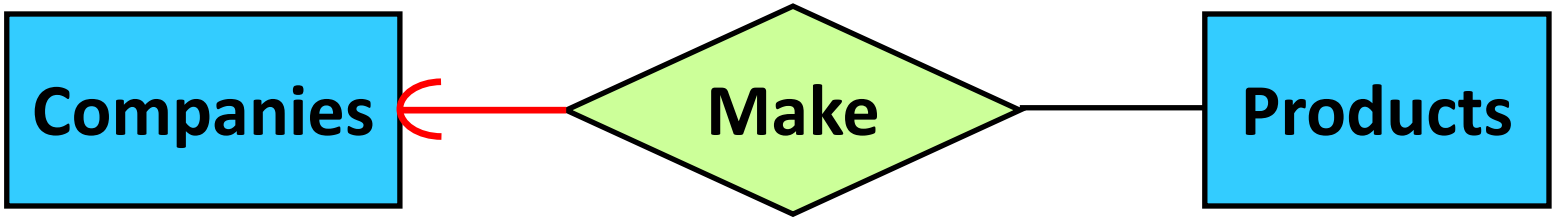

- What if every company should make at least one product?
- No arrow there …. but we indicate using degree constraints
- In general, a referential integrity constraint can only apply to the "one" side of
  - A many-to-one relationship, or
  - A one-to-one relationship
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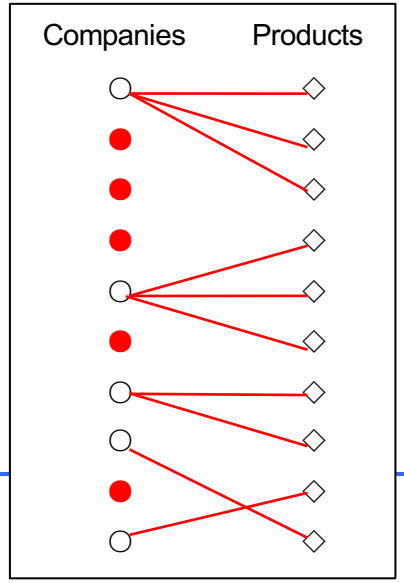
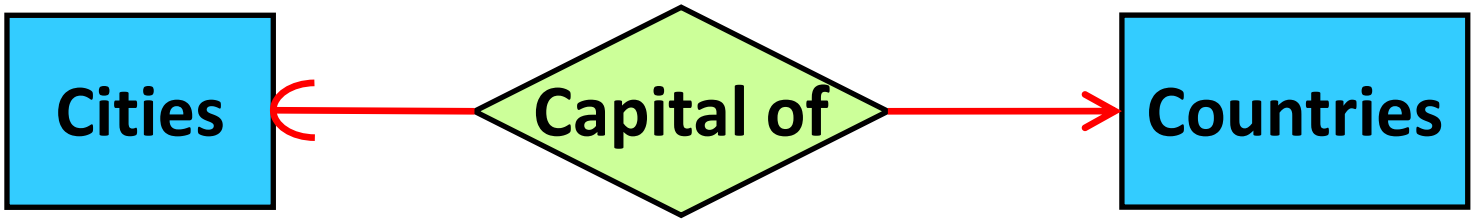


Referential Integrity: Exercise



- A city can be the capital of only one country
- A country must have a capital

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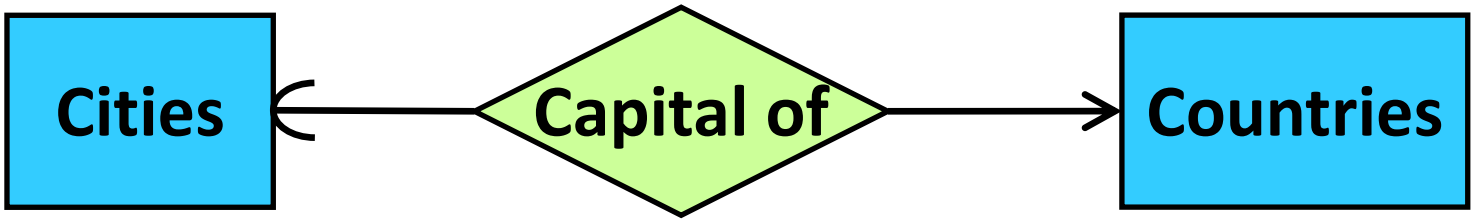

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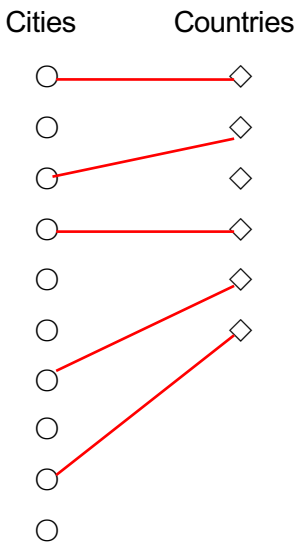

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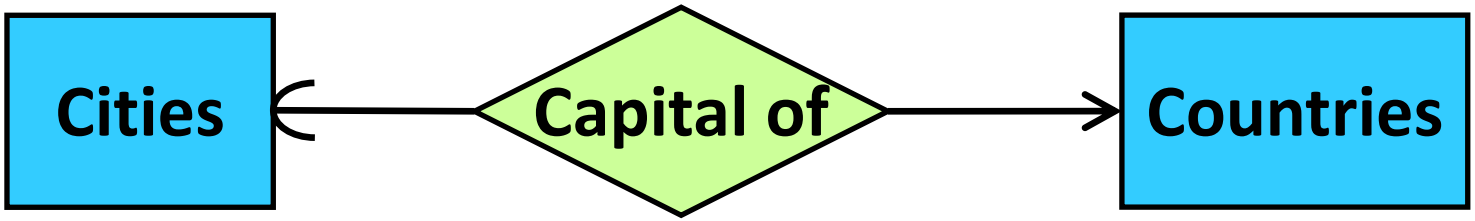

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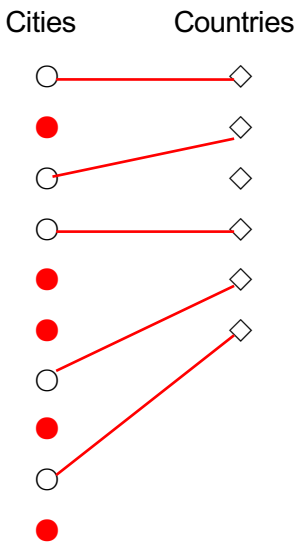

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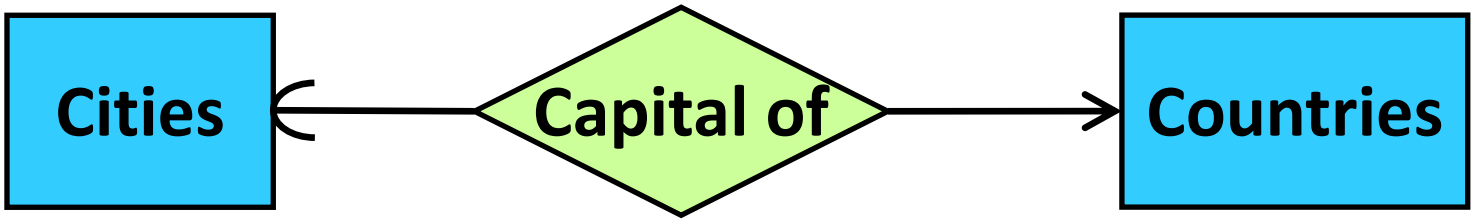

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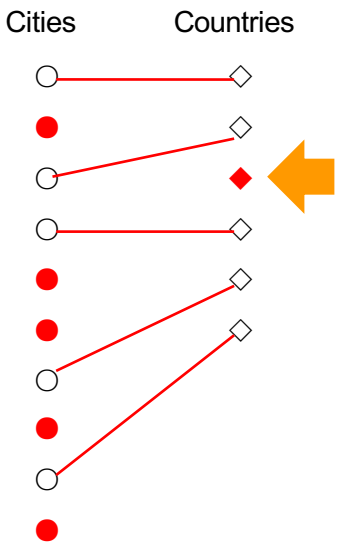

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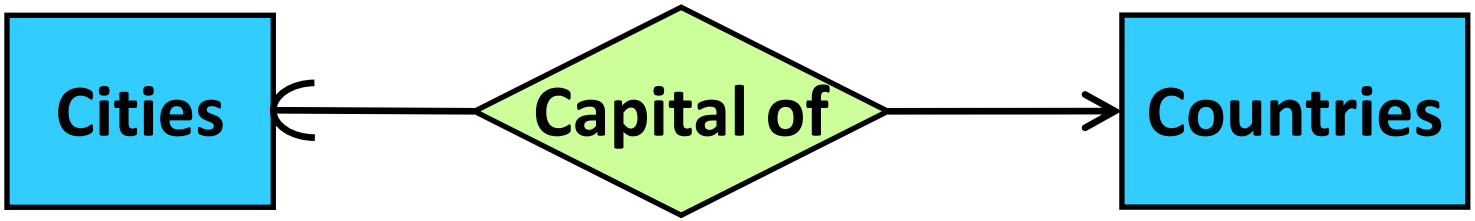

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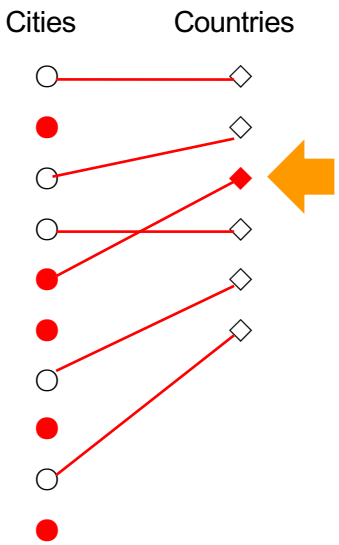

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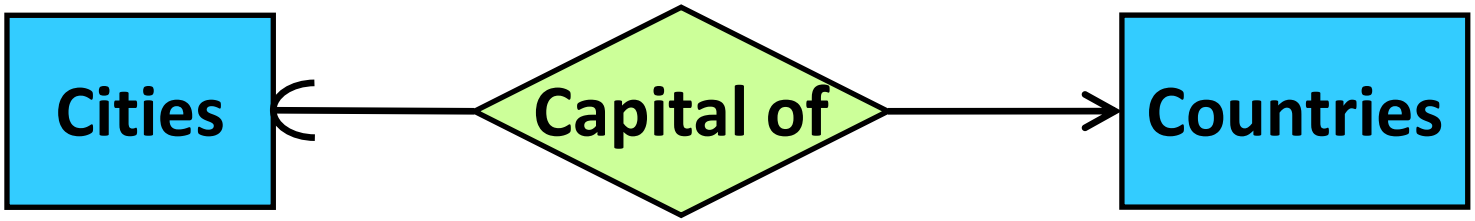

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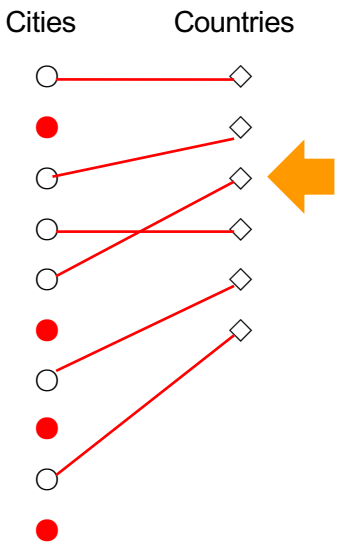
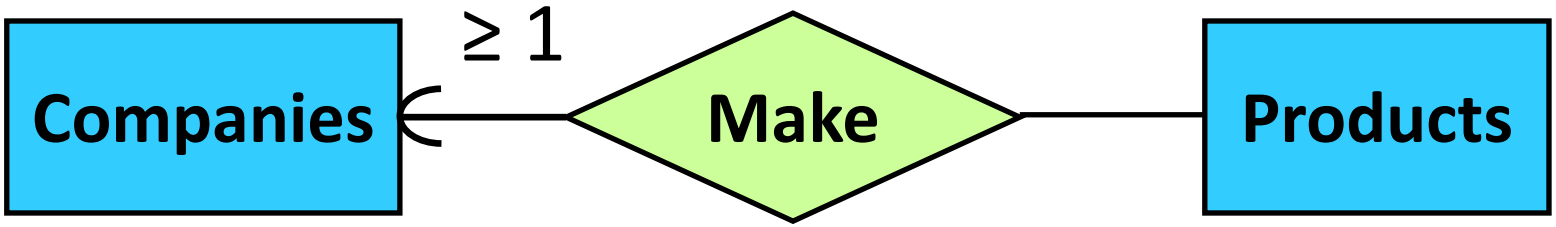


Referential Integrity: Exercise

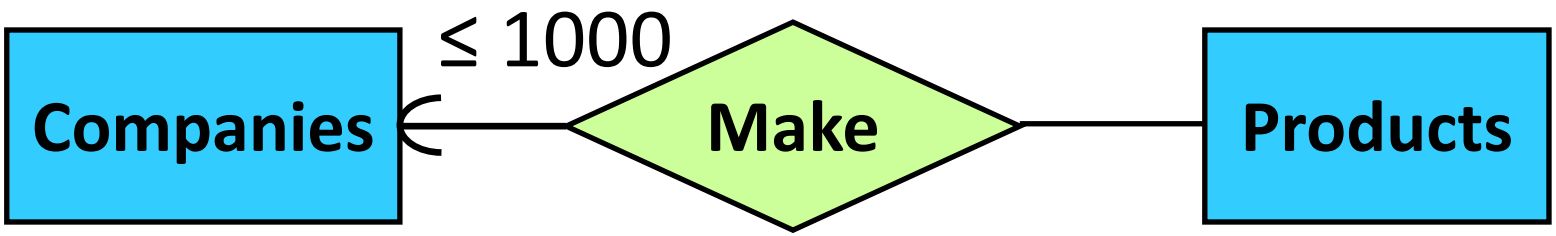
- A company must hire at least one person
- A person must be hired by exactly one company
- To say "Each and every company must hire at least one person", need degree constraints

Degree Constraint



- Each (and every) company should make at least one products

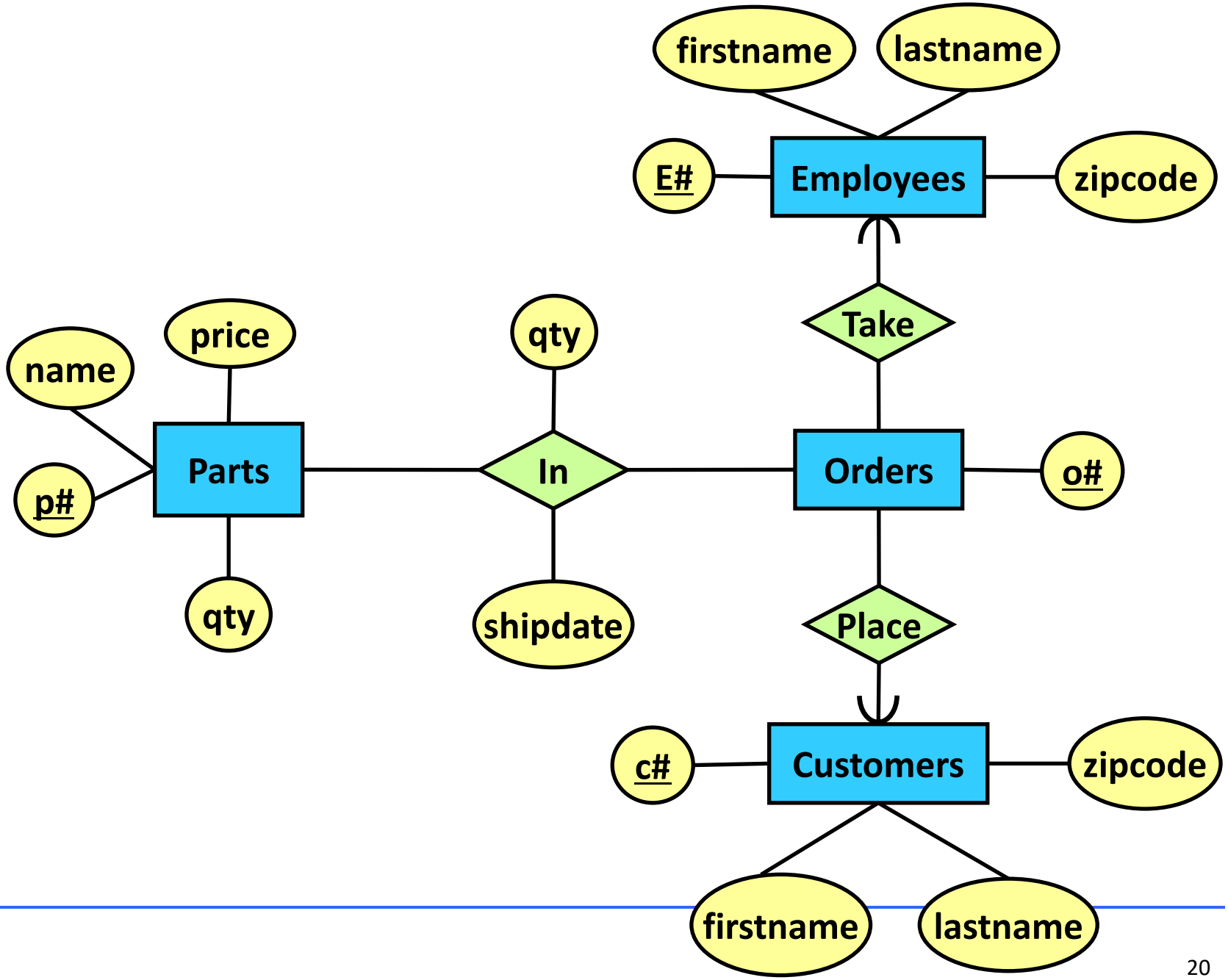
Degree Constraint



- Each (and every) company makes at most 1000 product
- Note:
  - Degree constraints are not easy to enforce in a DBMS
  - Key and referential integrity constraints can be easily enforced

ER Diagram Design: Exercise

- Consider a mail order database in which employees take orders for parts from customers. The requirements are:
- Each employee is identified by a unique employee number, and has a first name, a last name, and a zip code.
- Each customer is identified by a unique customer number, and has a first name, last names, and a zip code.
- Each part being sold is identified by a unique part number. It has a part name, a price, and a quantity in stock.
- Each order placed by a customer is taken by one employee and is given a unique order number. Each order may contain certain quantities of one or more parts. The shipping date of each part is also recorded.


firstname
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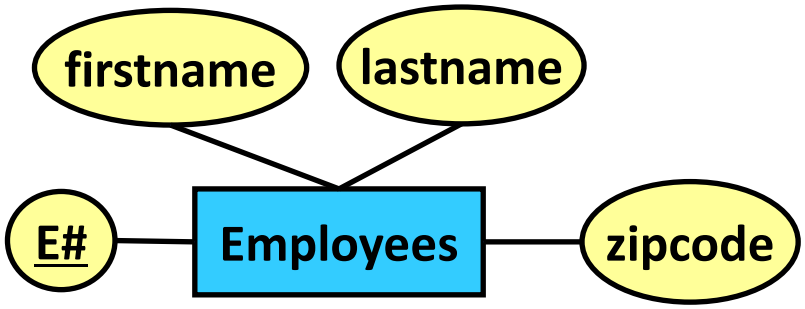
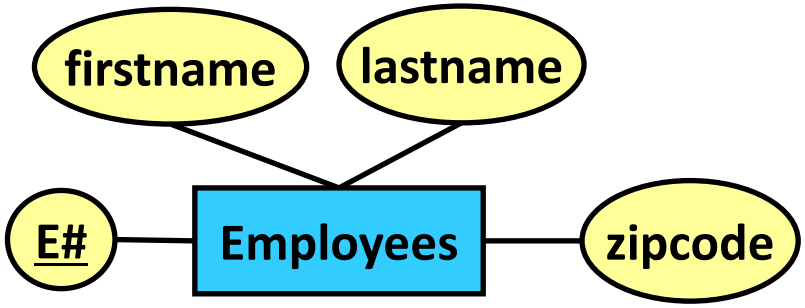


- Each employee is identified by a unique employee number, and has a first name, a last name, and a zip code.



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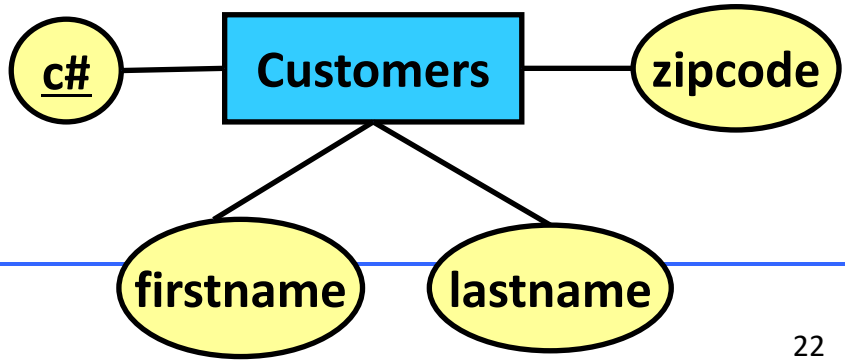
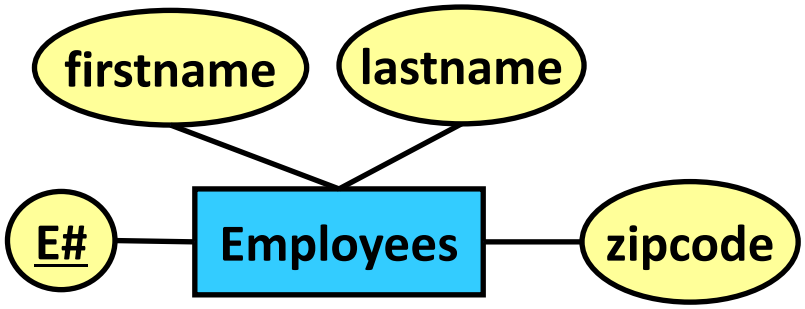
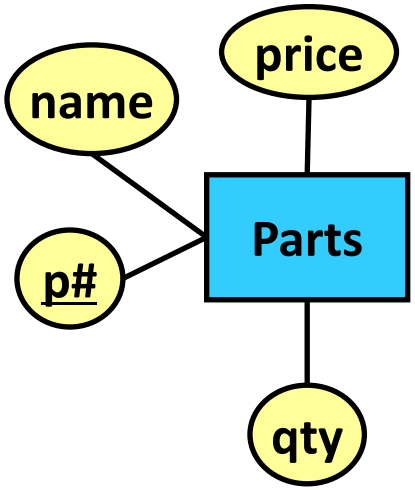
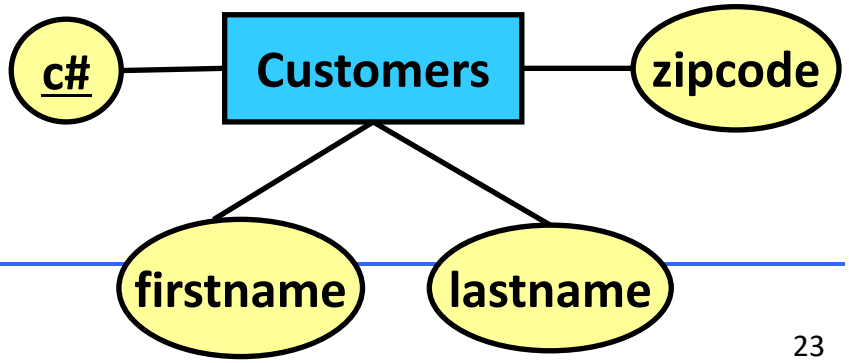
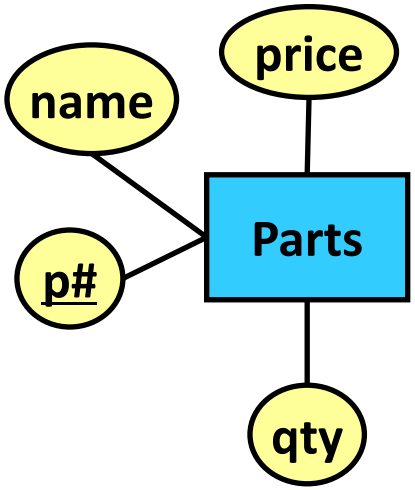


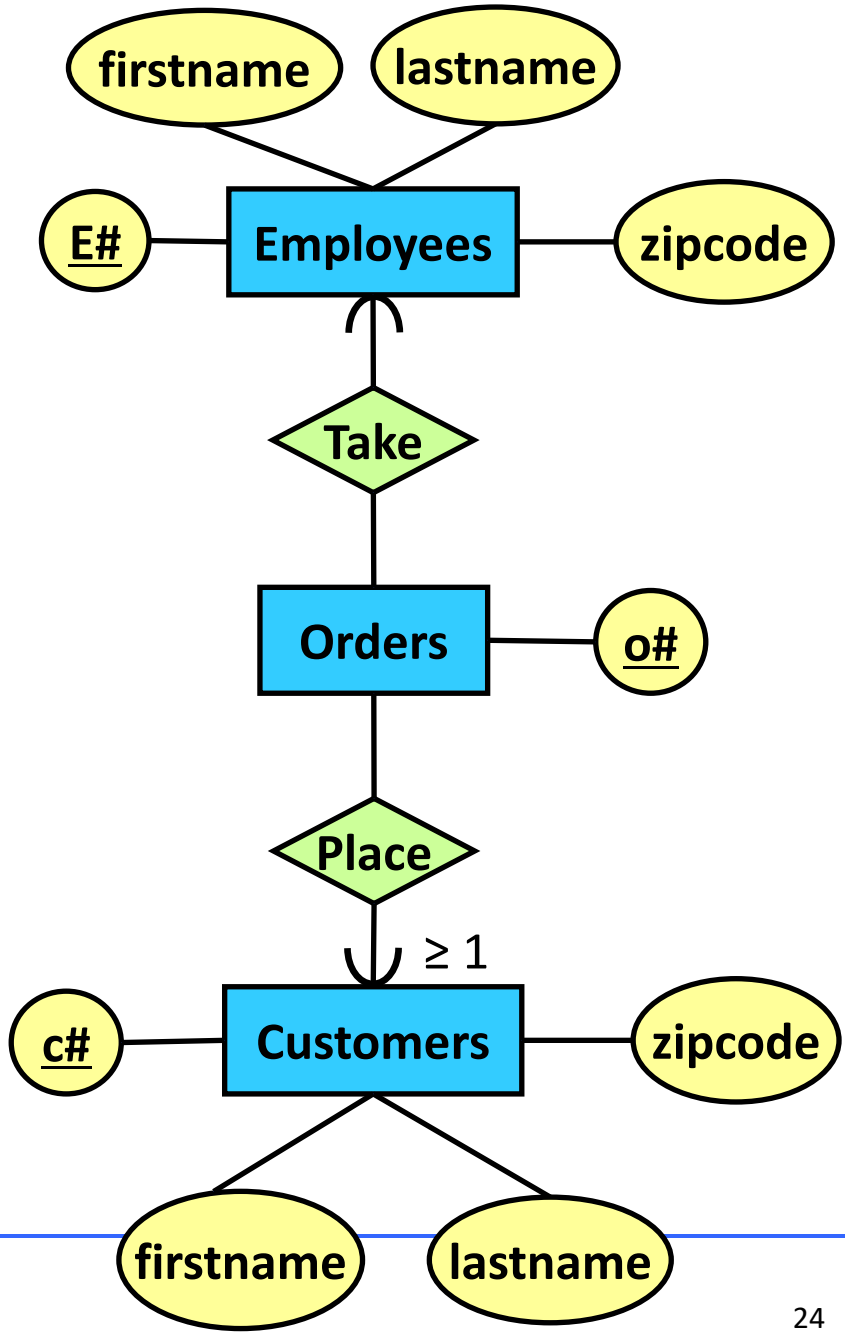




- Each part being sold is identified by a unique part number. It has a part name, a price, and a quantity in stock.







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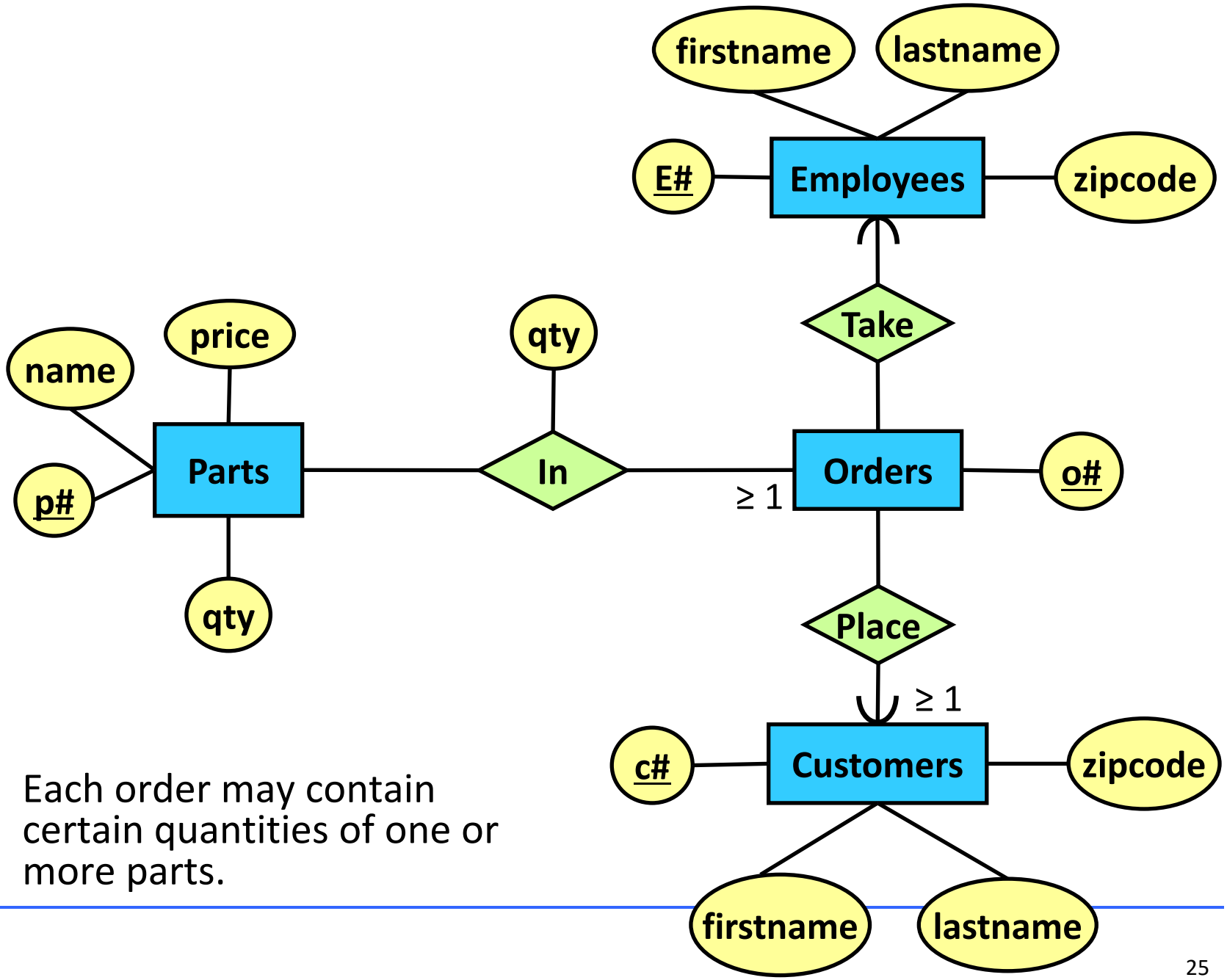
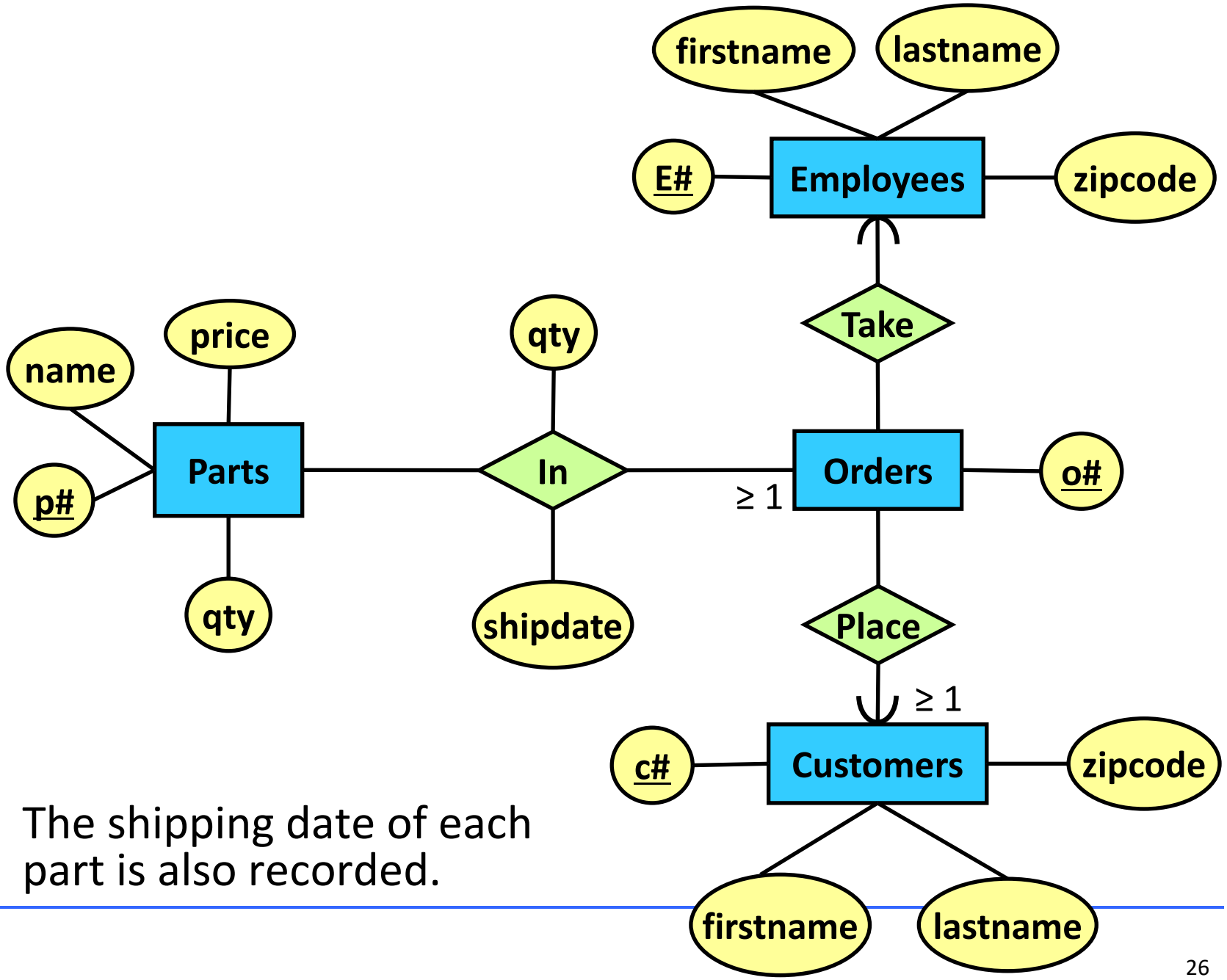


- Each order may contain certain quantities of one or more parts.

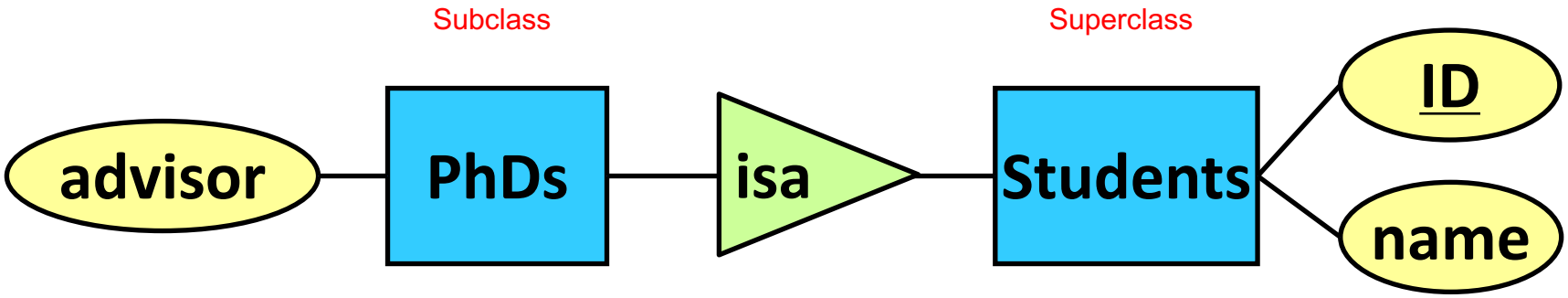


- The shipping date of each part is also recorded.

This Lecture

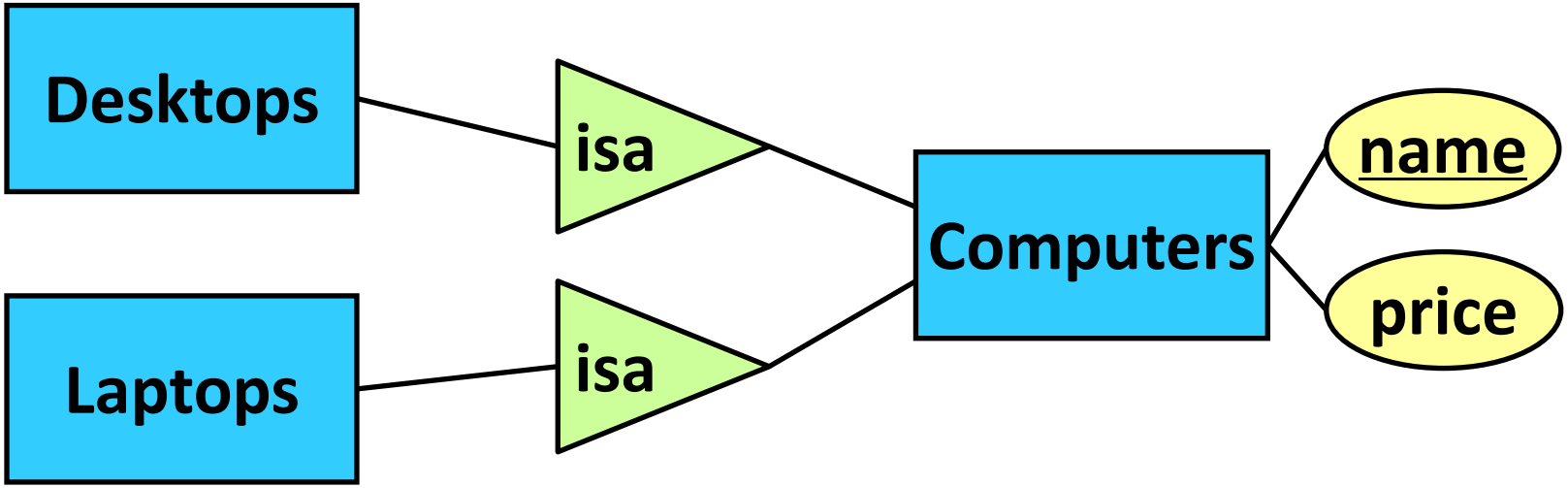
- Constraints
- Subclasses
- Weak Entity Sets

Subclass

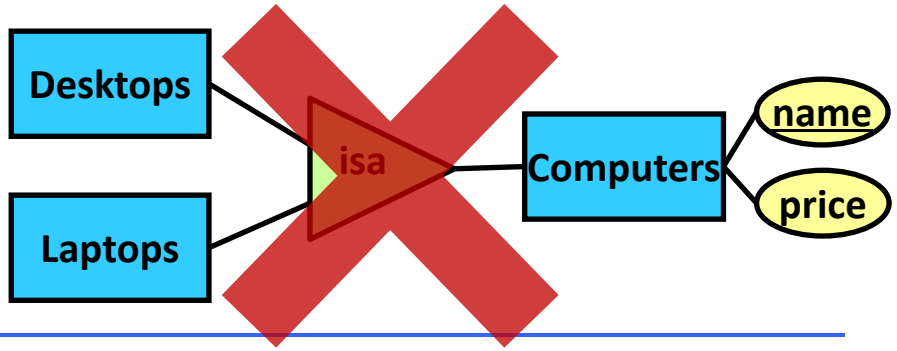


- PhDs are a special type of Students
- Subclass = Special type
- The connection between a subclass and its superclass is captured by the isa relationship, which is represented using a triangle
- Key of a subclass = key of its superclass
- Example: Key of Phds = Students.ID
- Students is referred to as the superclass of PhDs

Subclass



- An entity set can have multiple subclasses
- Example
  - Superclass: Computers
  - Subclass 1: Desktop
  - Subclass 2: Laptop

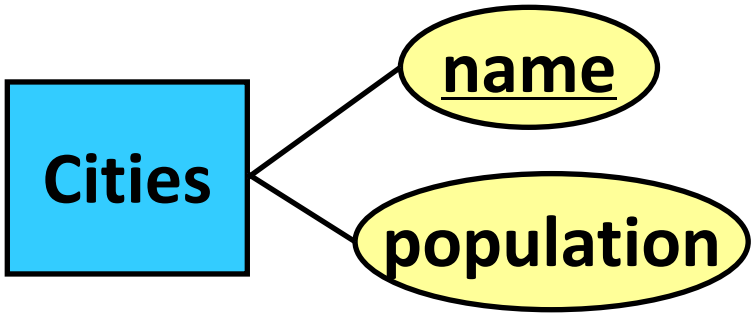


This Lecture

- Constraints
- Subclasses
- Weak Entity Sets

Weak Entity Sets

- Weak entity sets are a special type of entity sets that
  - cannot be uniquely identified by their own attributes
  - needs attributes from other entities to identify themselves
- Example: Cities in USA
- Problem: there are cities with identical names

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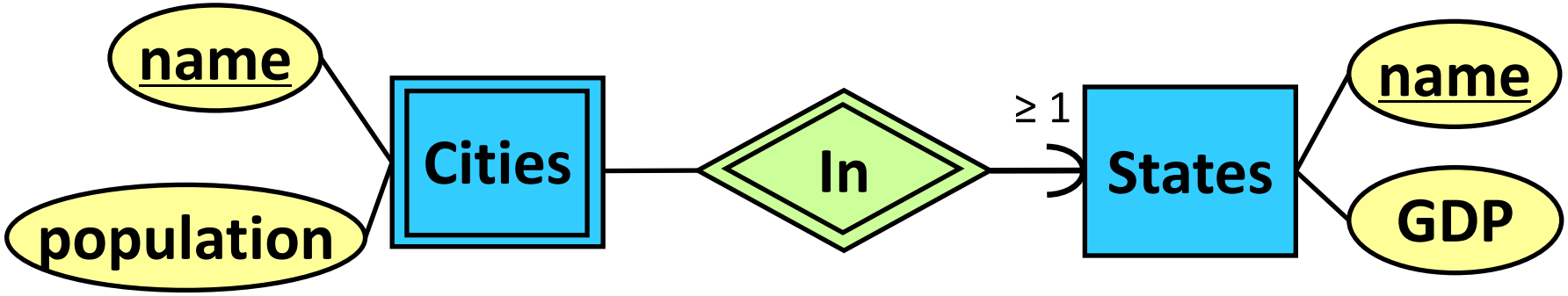
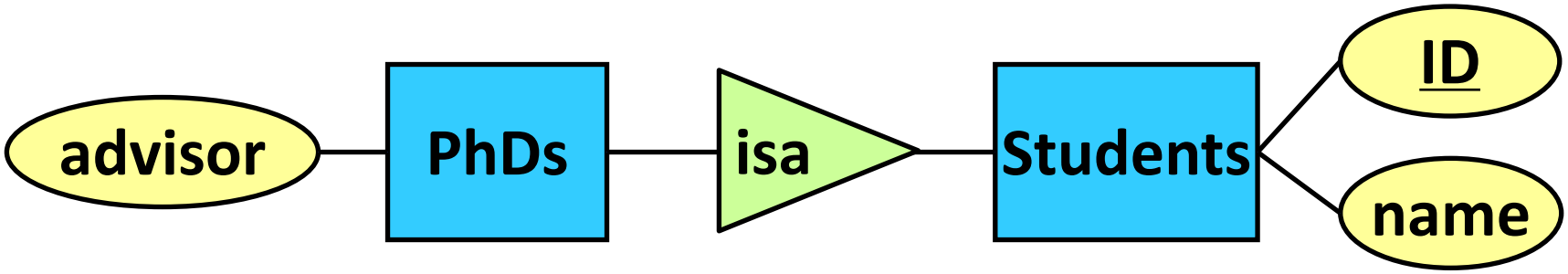
Madison, Illinois
Madison, Indiana
Madison, Kansas
Madison, Maine
Madison, North Carolina
Madison, Ohio
Madison, Pennsylvania
Madison, South Dakota
Madison, Tennessee
Madison, Virginia
Madison, West Virginia
Madison (town), Wisconsin, adjacent to the city of Madison
Madison Lake, Minnesota
Madison Park, Seattle, Washington State

Weak Entity Sets



- Problem: there are cities with identical names
- Observation: cities in the same state would have different names
- Solution: make Cities a weak entity set associated with the entity set States
- The relationship In is called the supporting relationship of Cities
- Weak entity set = Double-lined rectangle
- Supporting relationship = Double-lined diamond
- The key of Cities = (State.name, Cities.name)
- This is a single composite key

Subclass vs. Weak Entity Sets



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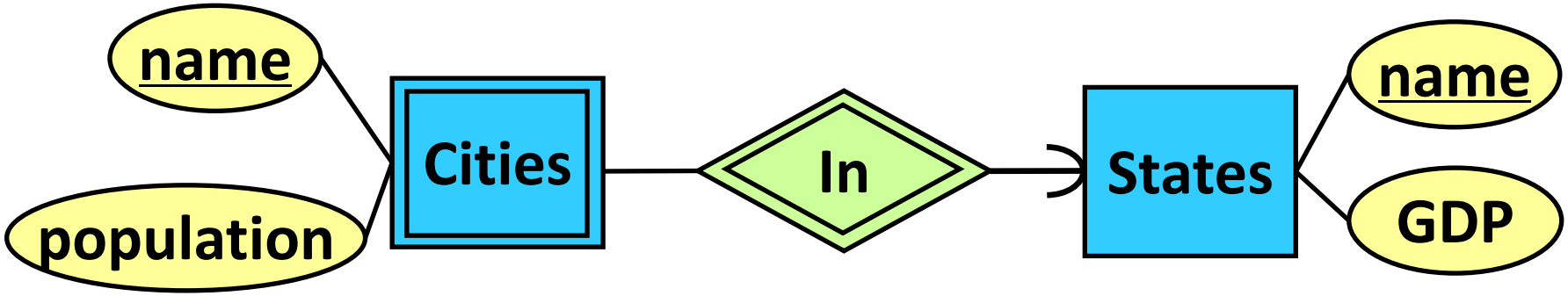

- Cities are NOT a special type of States

Exercise

- Consider two entity sets: Players and Teams
- Each player has a name and a number
- Each team has a name and a manager
- Each player plays for exactly one team, and is uniquely identified within the team by his/her number
- Each team is uniquely identified by its name
- Different players may have the same name
- Draw a ER diagram that captures the above statements
- What is the key of Players?

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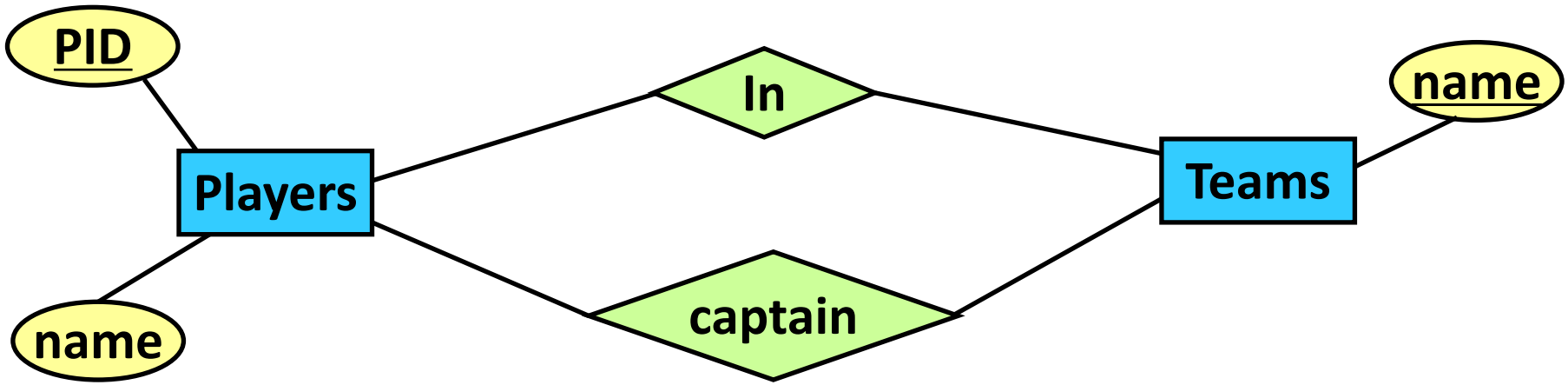
- Different players may have the same name
- Draw a ER diagram that captures the above statements
- What is the key of Players? (Players.number, Teams.name)

Exercise: ER-Diagram Design

- Record info about teams, players, and their fans, including:
  - For each team, its name, its players, its team captain (who is also a player)
  - For each player, his/her name, and the history of teams on which he/she has played, including the start and ending dates for each team
  - For each fan, his/her name, favorite teams, favorite players
- Additional information:
  - Each team has at least one player, and exactly one captain
  - Each team has a unique name
  - Two players (or two fans) may have the same name
  - Each fan has at least one favorite team and at least one favorite player



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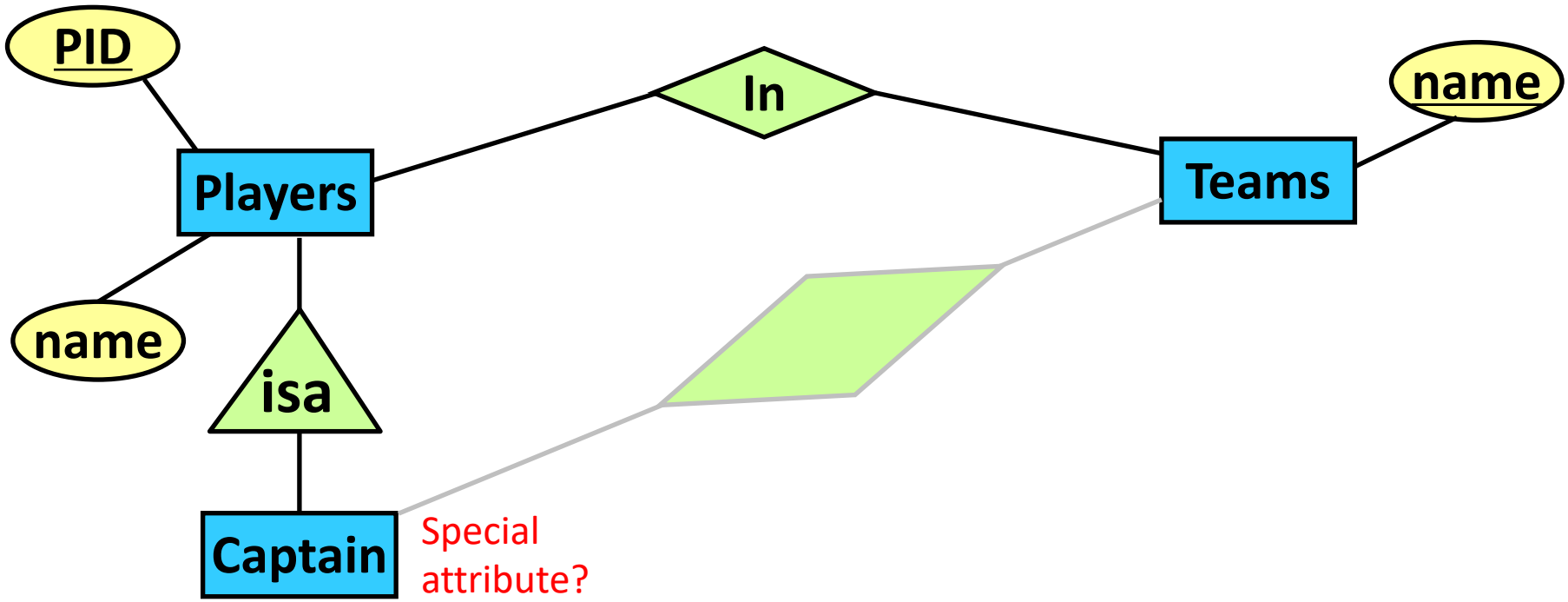
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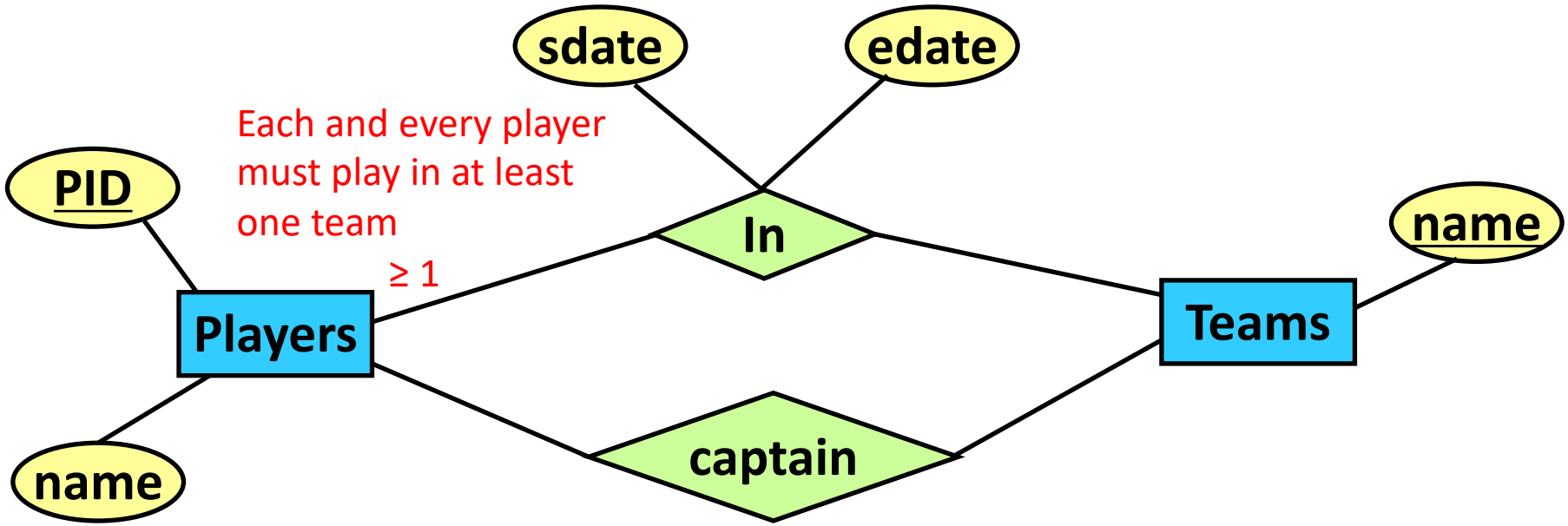
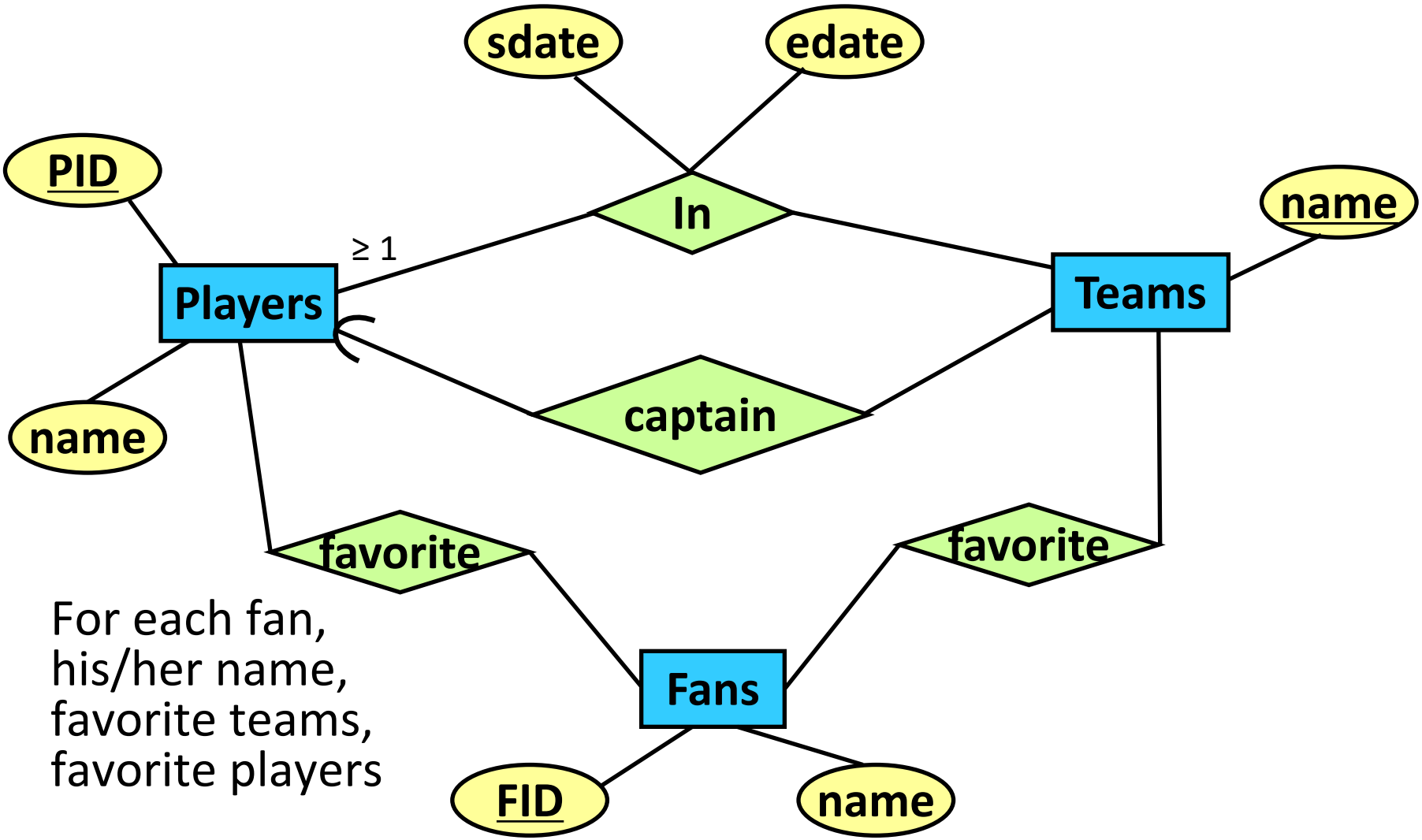
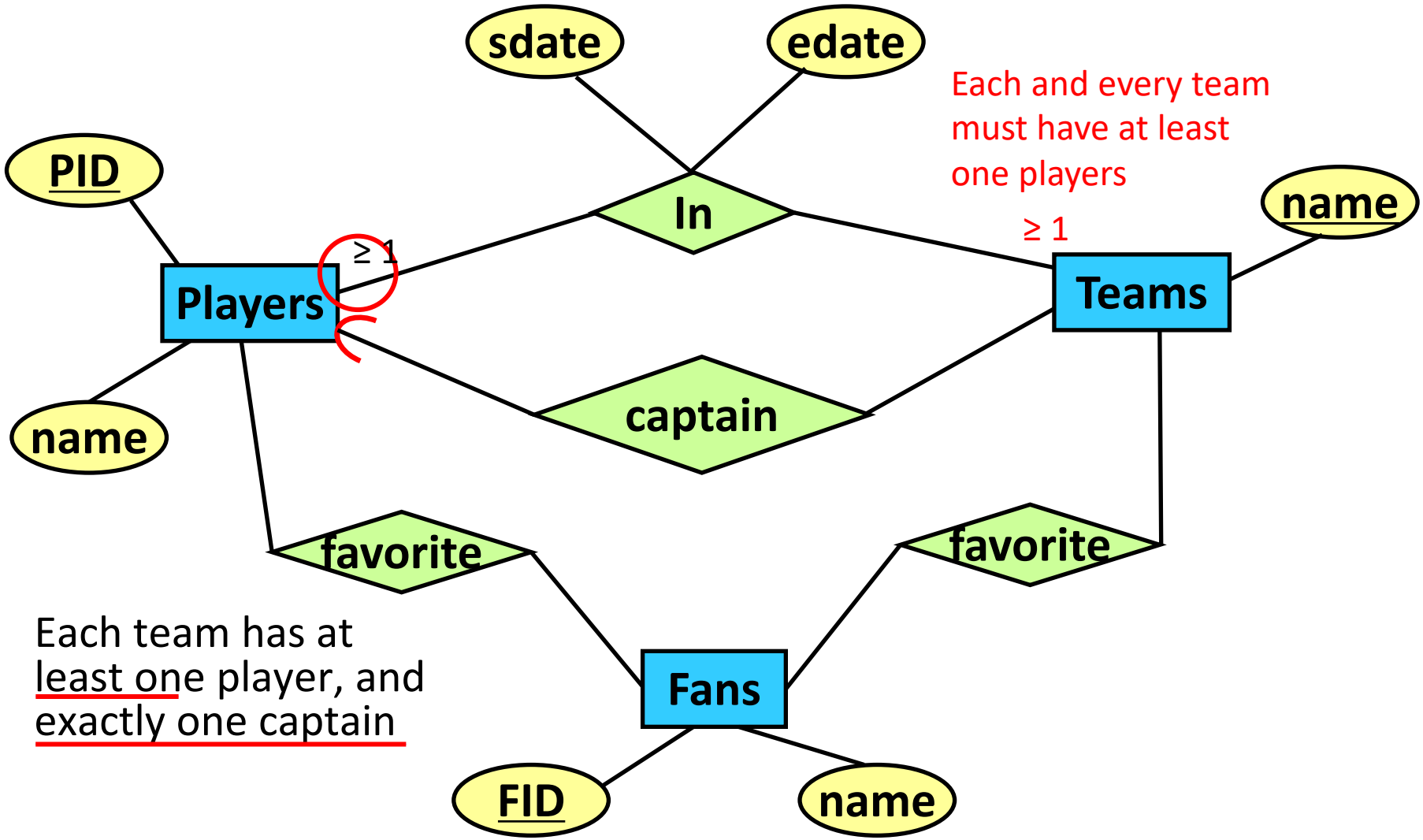


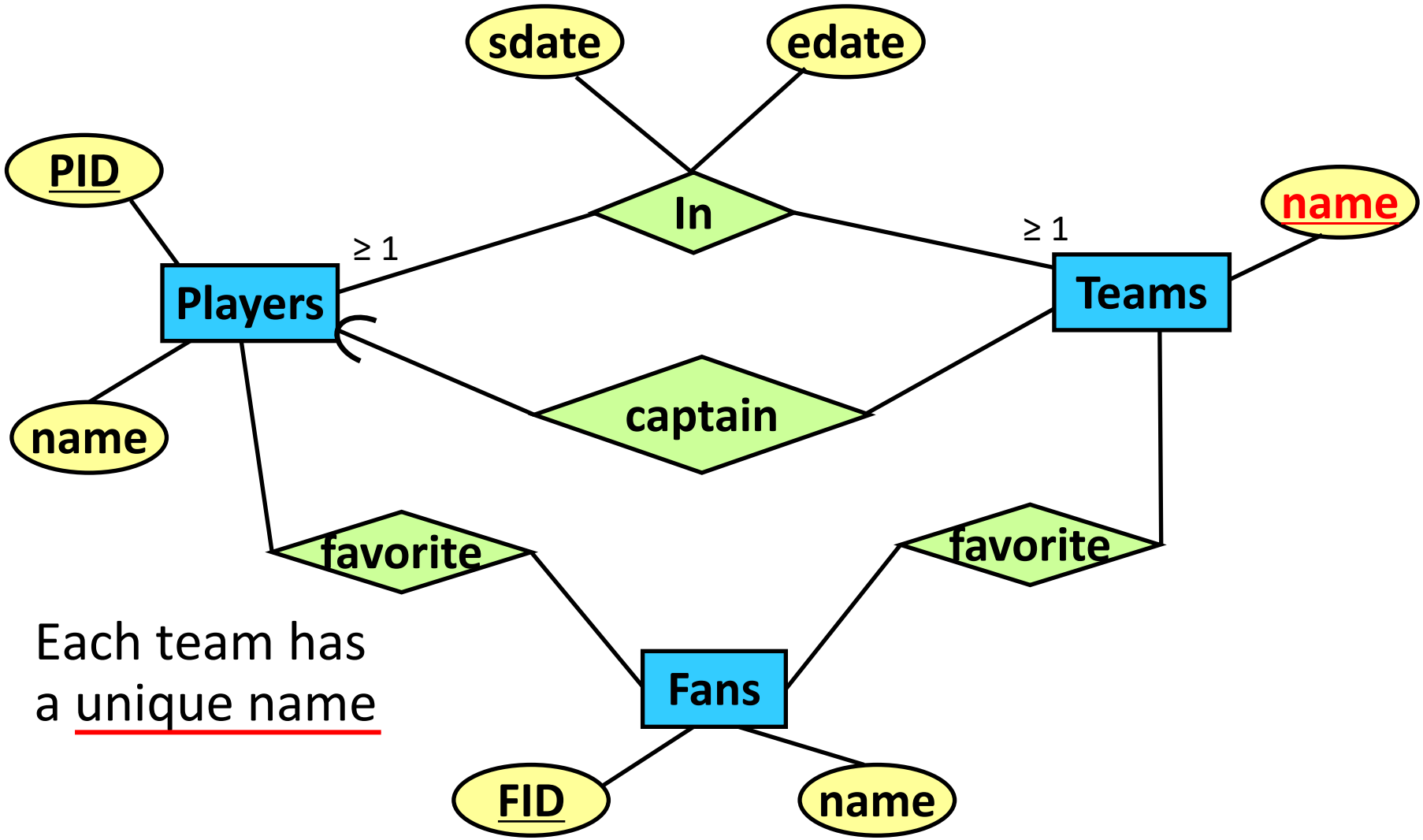
For each player, his/her name, and the history of teams on which he/she has played, including the start and ending dates for each team



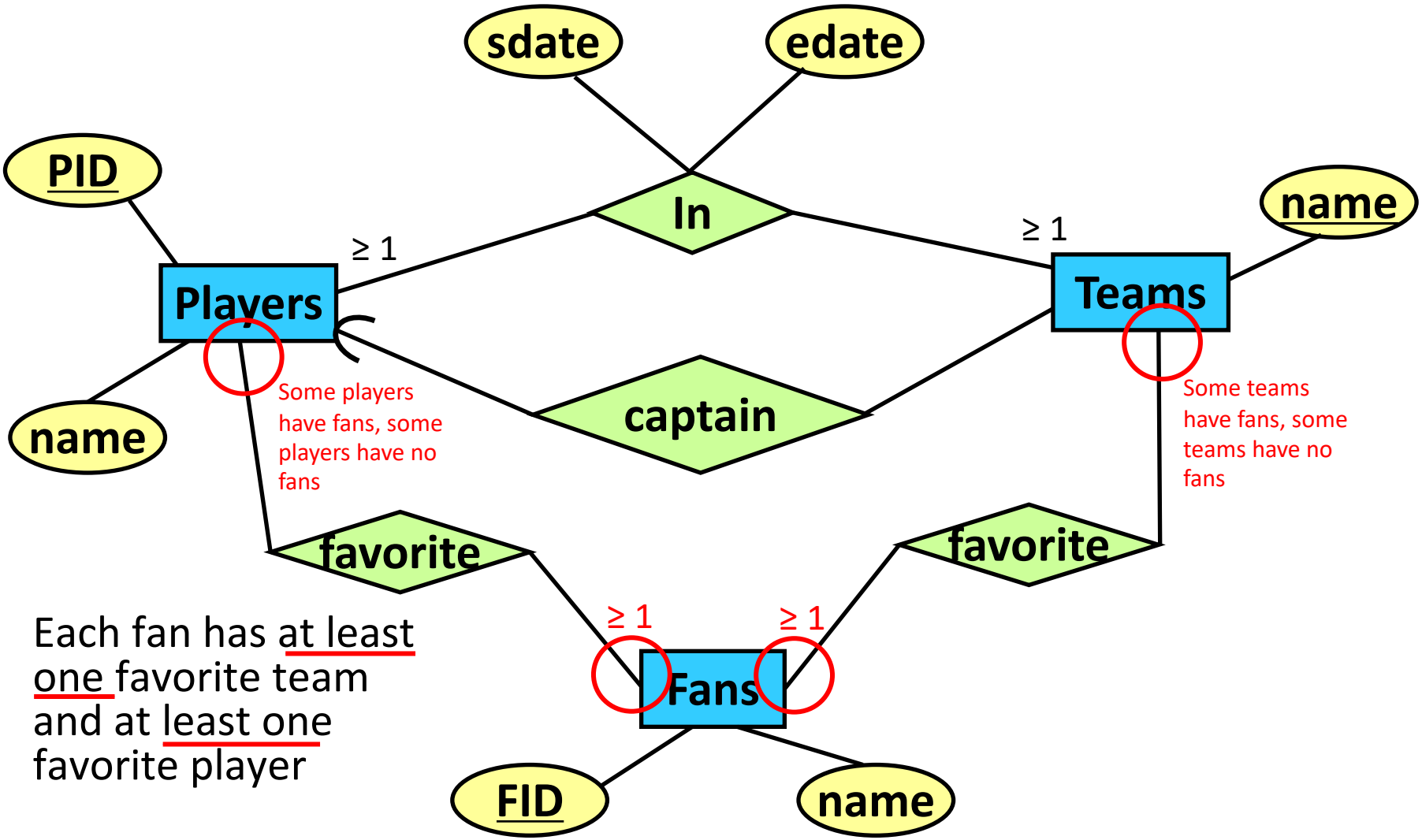
For each fan,
his/her name,
favorite teams,
favorite players



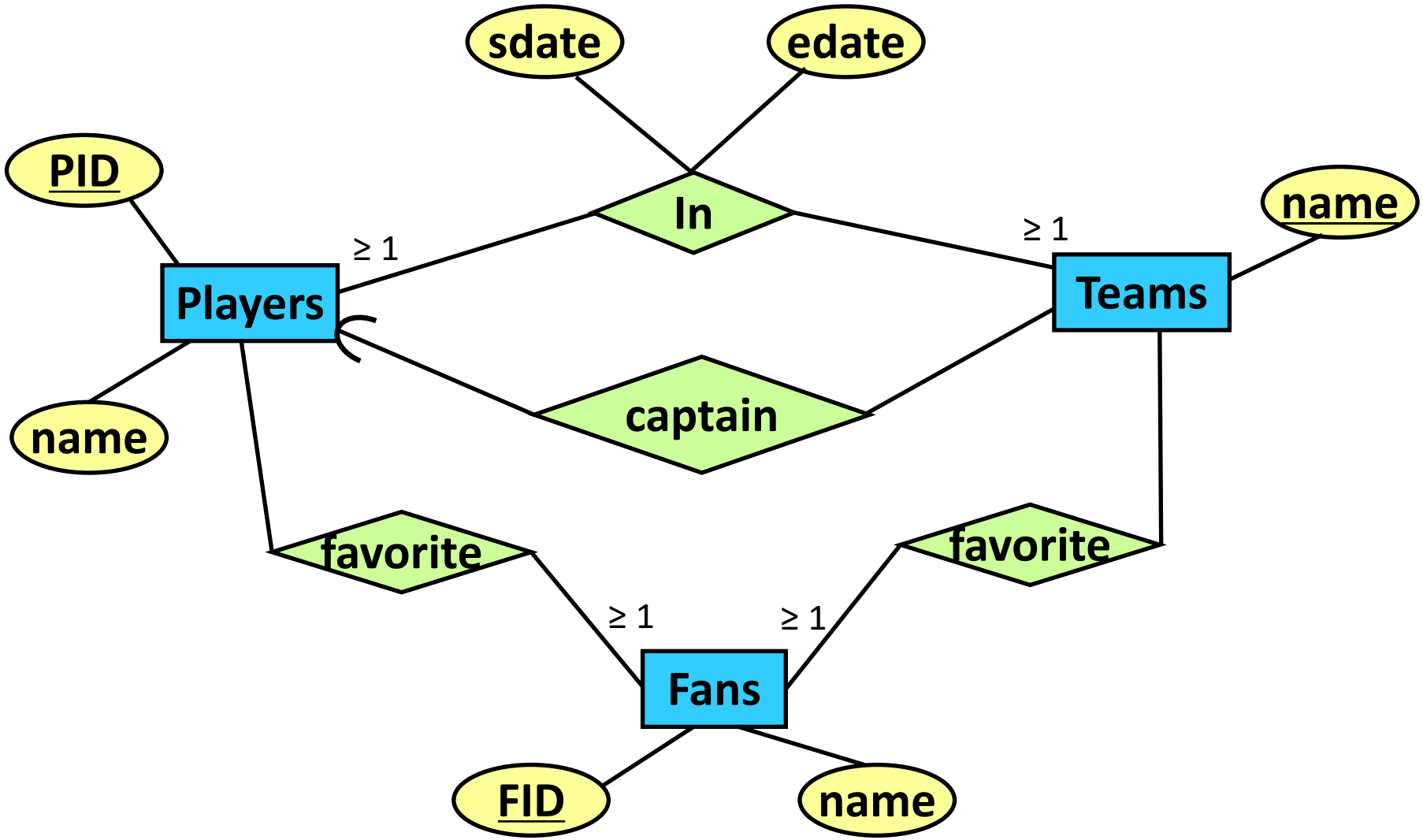
Each team has at least one player, and exactly one captain



Each team has
a unique name



Each fan has at least one favorite team and at least one favorite player


sdate
edate
PID
In
name
≥ 1
≥ 1
Players
Teams
captain
name
favorite
favorite
≥ 1
≥ 1
Fans
FID
name

To continue in

Topic 1: Entity Relationship Diagram (3)