# The Entity-Relationship Model (Part IV)

**R &G - Chapter 2**

# Announcement

- **Assignment 1 is available in Canvas**
  - ER diagram design
  - Due on 9/20
- **Submit your solution in Canvas**

# Conceptual ER Design

- **ER modeling can get tricky!**
- **Design choices:**
  1. Should a concept be modeled as an entity set or an attribute?
  2. Should a concept be modeled as an entity set or a relationship set?
  3. Relationships: Binary or ternary?

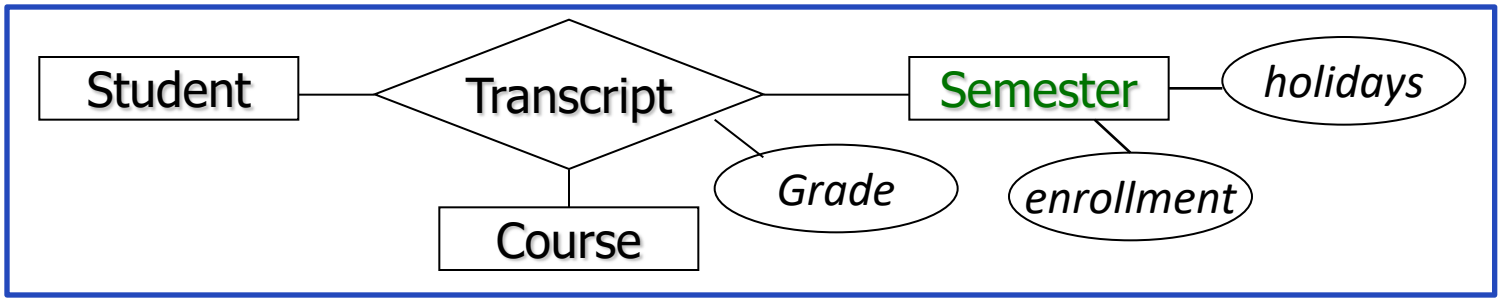
# Entity Sets VS Attributes

- A concept C should be defined as an entity set if one of the following conditions happens:
  - Rule 1: It is more than the name of something; it has at least one non-key attribute.
  - Rule 2: More than one instance of C can be associated with an entity.
  - Rule 3: More than one instance of C can be associated with one single relationship R.
- Otherwise, C should be defined as an attribute

# Entity Set vs. Attribute (Rule 1)

**Rule 1:** A concept C should be defined as an entity set if it is more than the name of something; it has at least one non-key attribute.

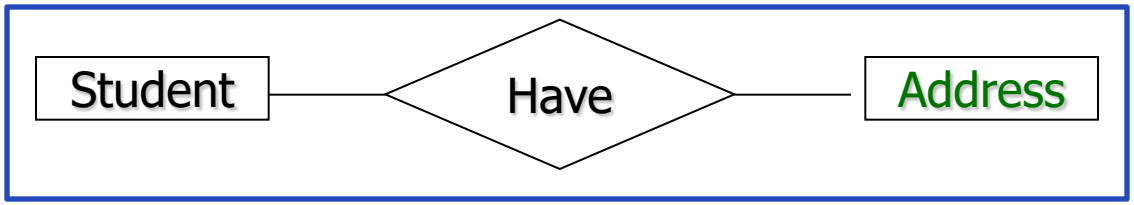
- Example: if each semester is associated with other information (enrollment, holidays, etc.), *semester* must be modeled as an entity set
  - The *enrollment* and *holidays* attributes are non-key attributes of semester.



# Entity Set vs. Attribute (Rule 2)

**Rule 2:** A concept C should be defined as an entity set if more than one instance of C can be associated with another entity.

- Example: each student can have multiple addresses
  - *Address* should be defined as an entity set.

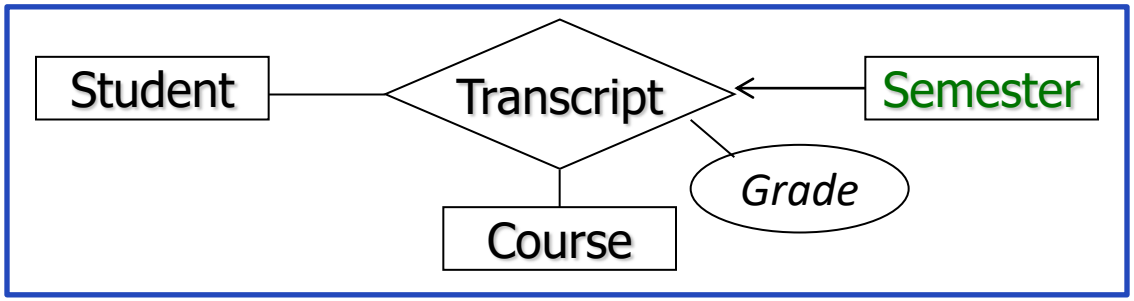



  - **Question**: if each student can only have one address, can *Address* be defined as an attribute of Student?

# Entity Set vs. Attribute (Rule 3)

Rule 3: A concept C should be defined as an entity set if more than one instance of C can be associated with one single relationship R.

- Example: The students can take the same course in different semesters
  - i.e., A (student, course) relationship pair can be associated with multiple semesters
  - *Semester* should be defined as an entity set.

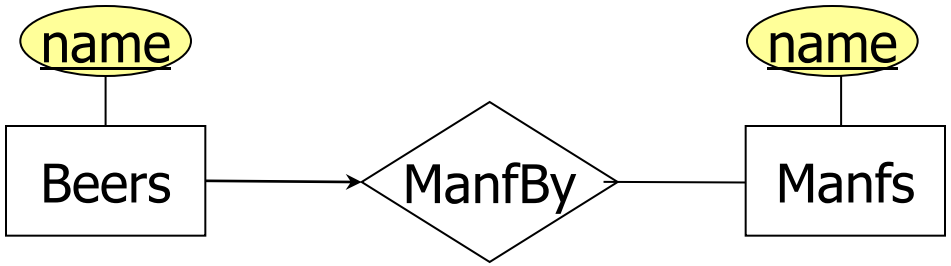



**Question**: if each student can take the same course only once, can *Semester* be defined as an attribute of Transcript?

# Exercise

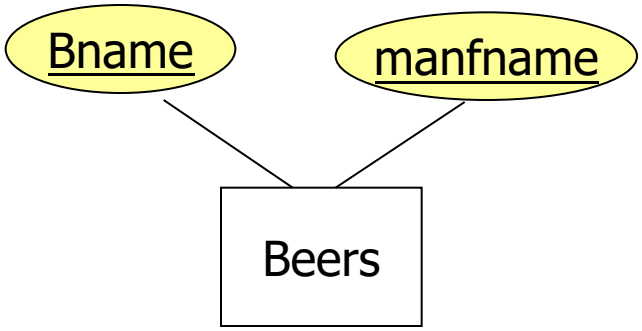
- **If each person has his/her contact information as one (and only one) phone number**
  - Should *contact information* be defined as an entity set or an attribute?
- **If each person has his/her contact information including phone numbers for daytime and nigh time.**
  - Should *contact information* be defined as an entity set or an attribute?

# Don’t use an entity set when an attribute will do




Bad

- Since the manufacturer is nothing but a name, and is not at the “many” end of any relationship (i.e., each beer only associates with one manufacturer), it should not be an entity set but an attribute

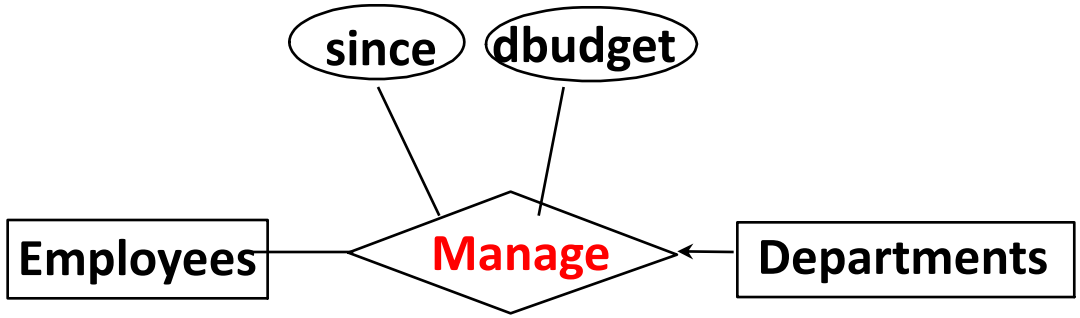



Good

# Conceptual Design Using the ER Model

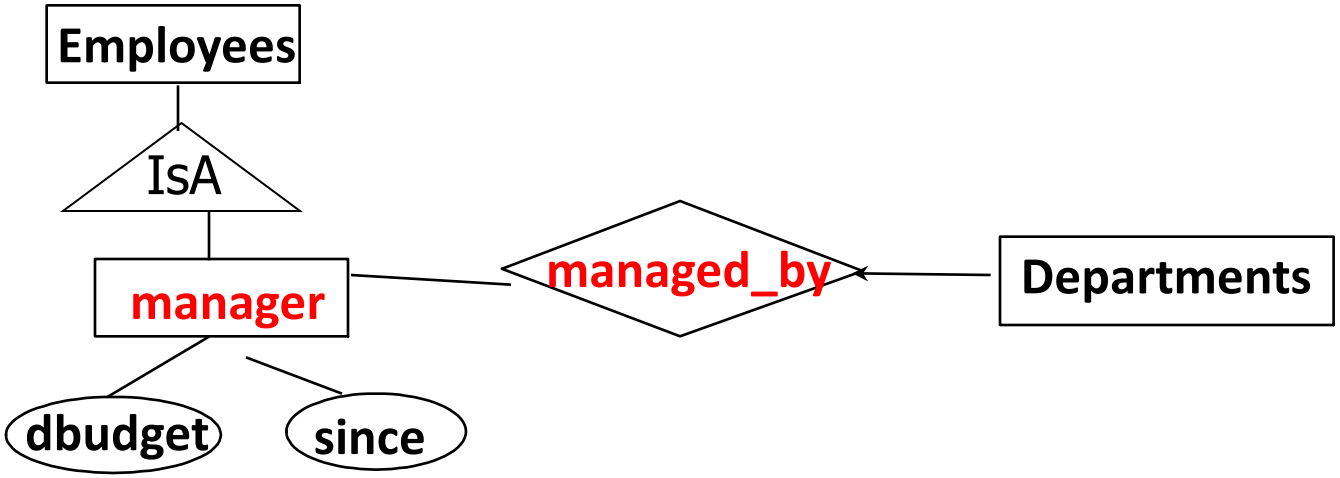
- **ER modeling can get tricky!**
- **Design choices:**
  1. Should a concept be modeled as an entity set or an attribute?
  2. Should a concept be modeled as an entity set or a relationship set?
  3. Relationships: Binary or ternary?

# Design Issue #2: Entity Set vs. Relationship




Schema 1

Question: should *Manages* be an entity set or a relationship?



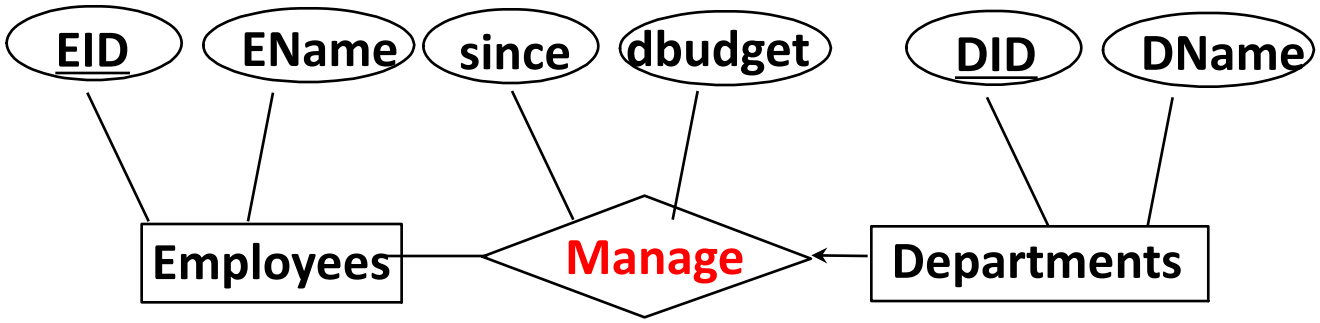

Schema 2

# Design Principles

- At semantic level
  - If a concept describes the association between multiple entity sets, define it as a relationship set. Otherwise, define it as an entity set.

- Be careful of where to put attributes
  - If attribute A is associated with the entity set E
    - Each instance of E only has one A value
  - If attribute A is associated with the relationship set R(E, E')
    - Each instance of R(E, E') only has one value of A
    - Each E/E' instance can have multiple A values

# Difference between Two Schemas




- Schema 1: *Manage* as a relationship, with attributes "since" and "dbudget"

| EID | EName |
|---|---|
| 10001 | Adam |
| 10002 | Hanna |
| … | … |

Employee table

| DID | DName |
|---|---|
| D1 | IT |
| D2 | HR |
| D3 | Marketing |

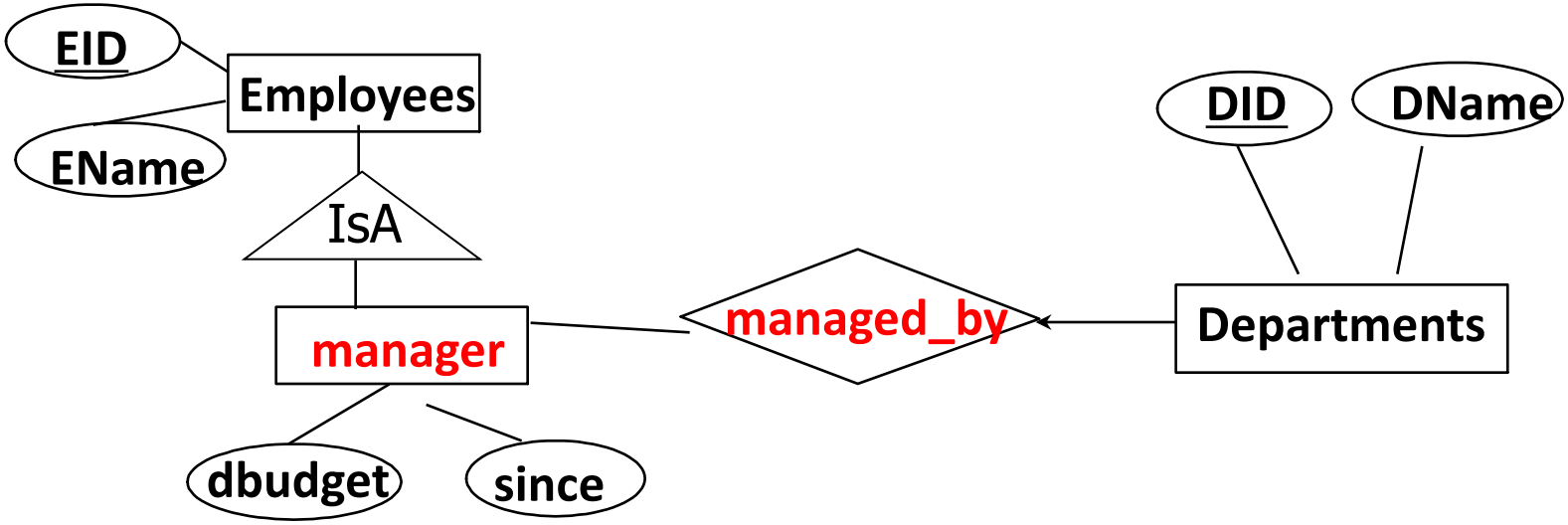
Departments table

| EID | DID | Since | Dbudget |
|---|---|---|---|
| 10001 | D1 | 1/1/2020 | 100K |
| 10001 | D2 | 9/1/2020 | 300K |
| 10002 | D3 | 1/1/2020 | 300K |
| … | … | | |

Manage table

- Each manager (e.g., Adam) can have more than 1 "Since" and "Dbudget" values

# Difference between Two Schemas




- Schema 2: *Manager* as an entity set, with attributes "since" and "dbudget"

| EID | EName | Since | Dbudget |
|---|---|---|---|
| 10001 | Adam | 1/1/2020 | 100K |
| 10001 | Hanna | 9/1/2020 | 300K |
| … | … | | |

Employee table

| DID | DName |
|---|---|
| D1 | IT |
| D2 | HR |
| D3 | Marketing |

Departments table

| EID | DID |
|---|---|
| 10001 | D1 |
| 10001 | D2 |
| 10002 | D3 |
| … | … |

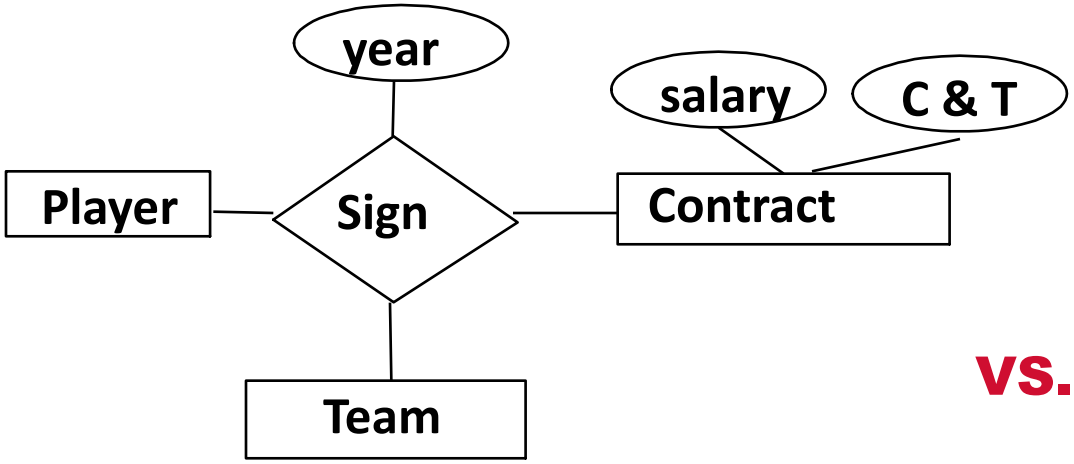
Manage table

- Each manager (e.g., Adam) can have only 1 "Since" value and 1 "dbudget" value.

# Exercise

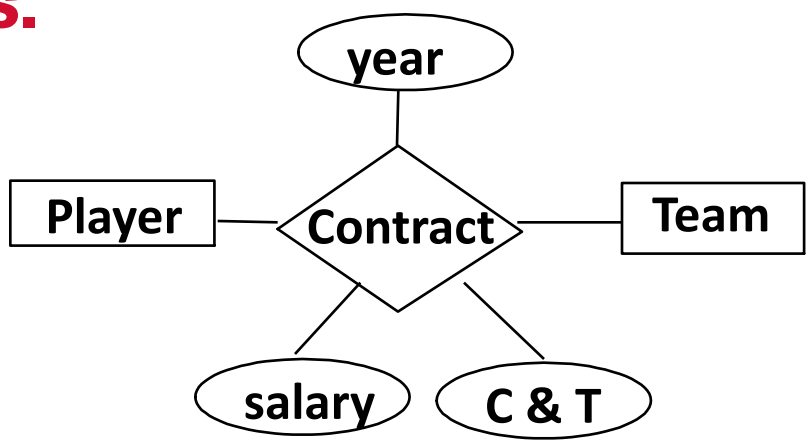
- Three concepts:
  - *NBA players* (name, height, age, position)
  - *Contracts* (salary, conditions & terms)
  - *Teams* (name, city, coach)
- Each NBA player signs a contract with a particular team.
- Design an ER diagram that describes the contracts that NBA players signed with teams for each year.

# Exercise (Cont.)




Schema 1
(Contract defined as entity set)

vs.




Schema 2
(Contract defined as relationship)



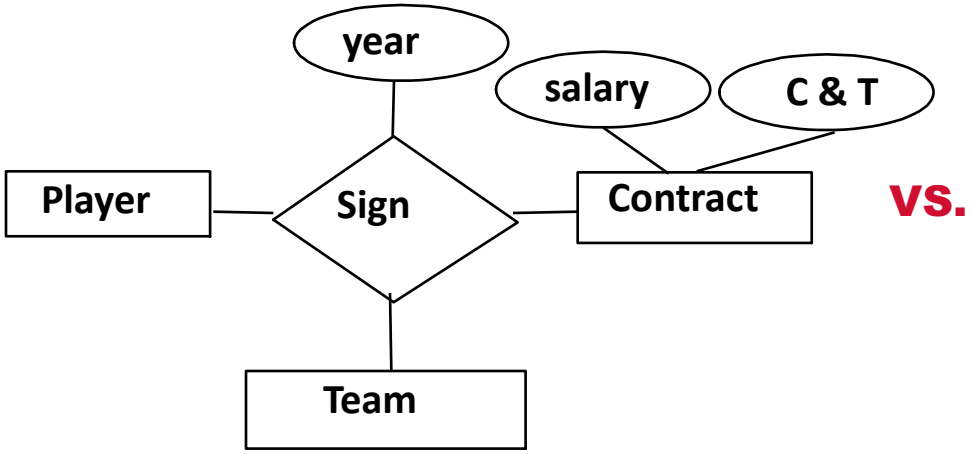
Note: the attributes of *Players* and *Team* are omitted (they are obvious from data description)

# Exercise (Cont.)

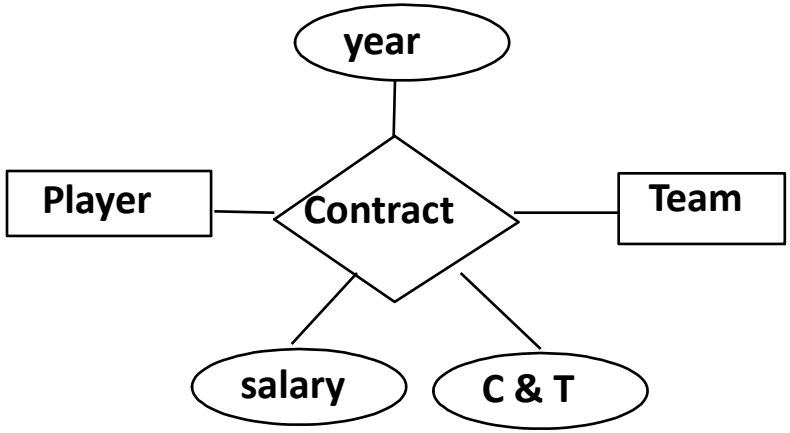
Consider the following facts:

- The salary and C&T on the contracts can be modified during the year.
- A contract with modified salary and C&T will be considered as a different contract.
- In other words, a player can sign more than one contract with the same team in the same year.

Which schema is correct?




VS.




Schema 1 (Contract defined as entity set)

Schema 2 (Contract defined as relationship)

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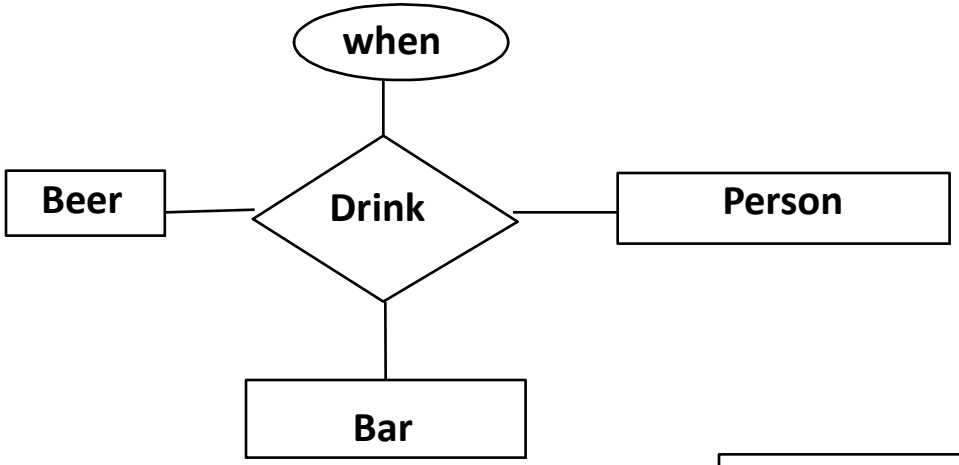
# Design Issue #3: Binary vs. Ternary Relationships

- Are binary relationships always better than ternary relationship?

- Consider the following example
  - There are three entity sets Person, Bar and Beers.
  - Design the relationship(s) that record the information of who drank which beer at which bar and when.

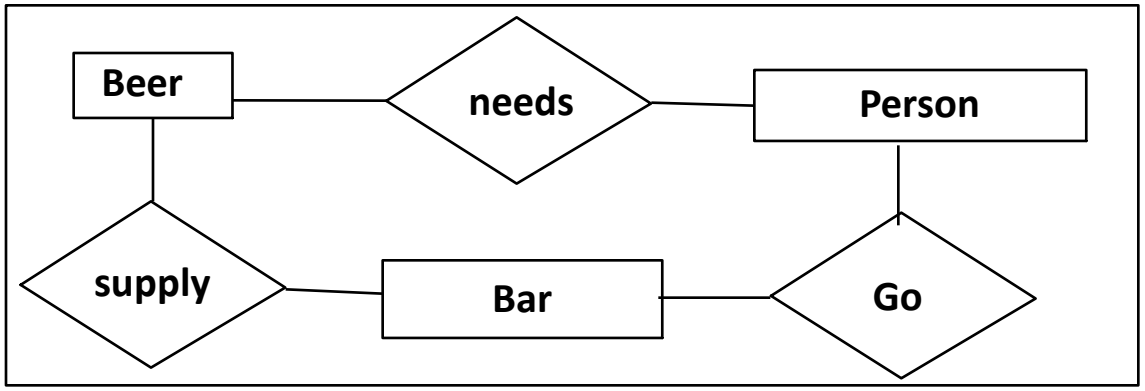
# Design Issue #3: Binary vs. Ternary Relationships




Schema 1

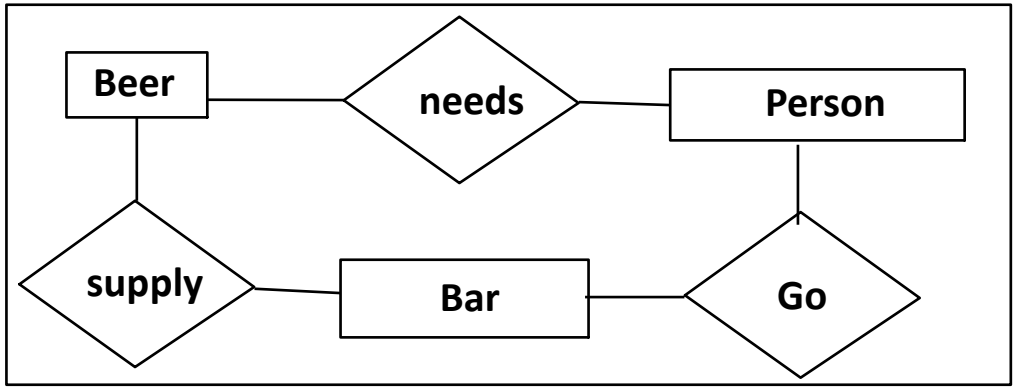
**vs.**

Schema 2

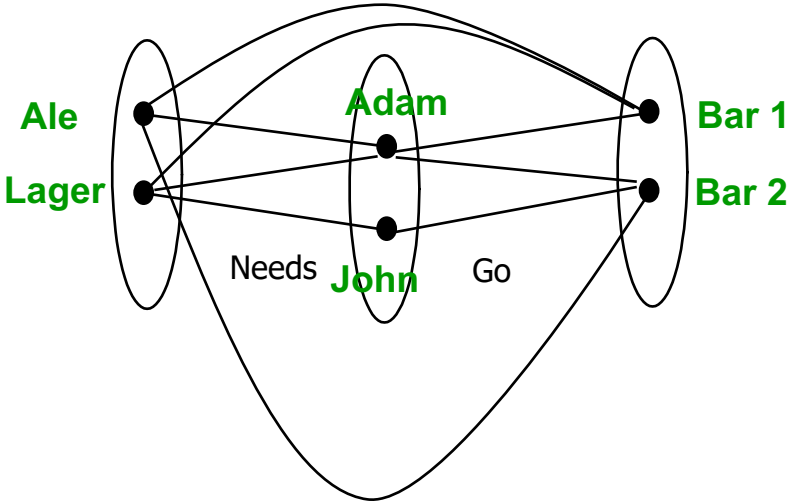



- Which schema is correct?

# Design Issue #3: Binary vs. Ternary Relationships




Supply




1. Bar 1 "supply" Ale and Lager
2. Adam "needs" Ale and Lager
3. Adam "go" to Bar 1

Questions:

- Does these three facts imply that Adam went to Bar 1 and drank Ale?
- How to record *when*?

- Using binary relationship sets is wrong for this example
- A ternary relationship set is needed when the three entity sets participate in a single relationship.