Entity-Relationship model Weaknesses

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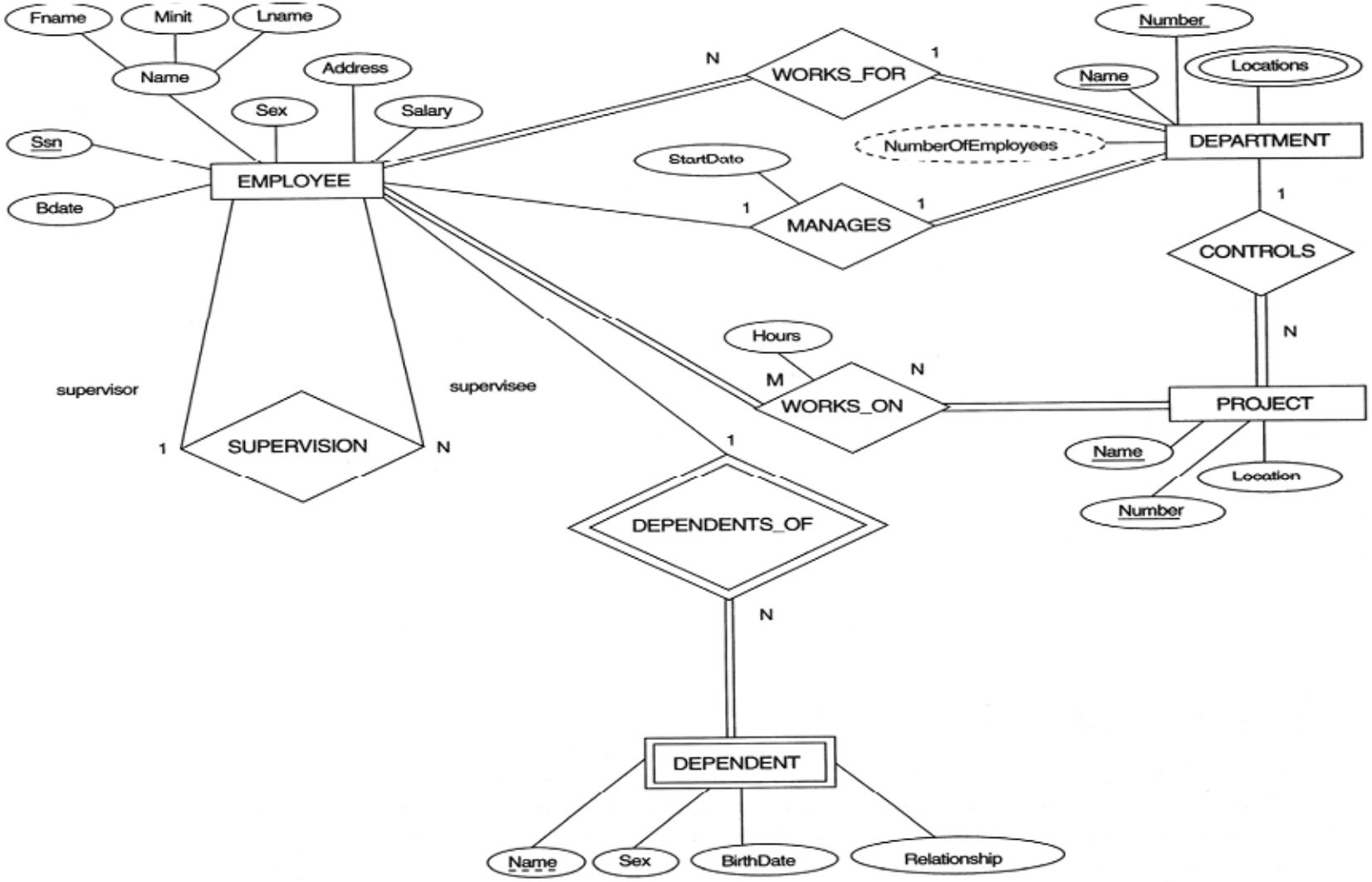
1. ER model - An example



1. ER model

- **What ? Why?**
  - A basic tool in database design : a conceptual data model is independent of physical or implemental details.
  - Easily understood by ordinary users : capturing the basic semantics
  - Limited expressive power vs formality, simplicity and wide application

1. ER model

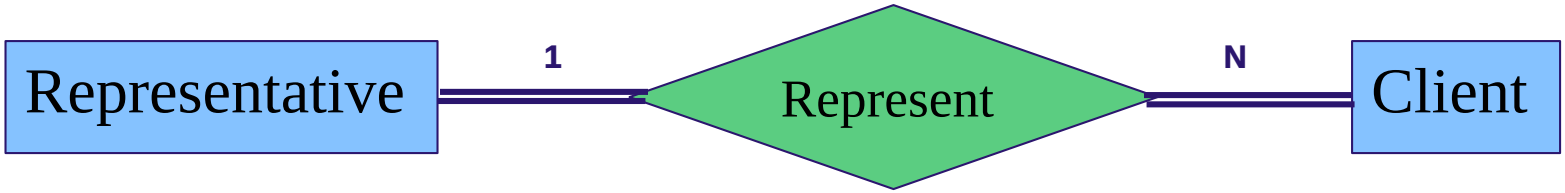
- **Database requirements**
  - Supporting more complex applications.
  - Capturing more domain semantics.
- → **Enhancements and extensions to ER model : very important.**
- **Addition properties :**
  - Motivated
  - Minimal
  - At the conceptual level
  - Powerful

1. ER model weaknesses

- **ER model = Entities + Relationships + Attributes**
  - Combined in certain ways, not freely

- **Relation constraints :** information expressed by relationships on relationships. (e.g connection traps)
- **Attribute constraints :** information expressed by relationships on attributes.
- **Lack of information** about entities and relationships.

1. Lack of information



- **Rules :**
  - Every client must have a representative.
  - Every representative must assist several clients.
- **Not express :**
  - Representative must have the **same** number of clients.

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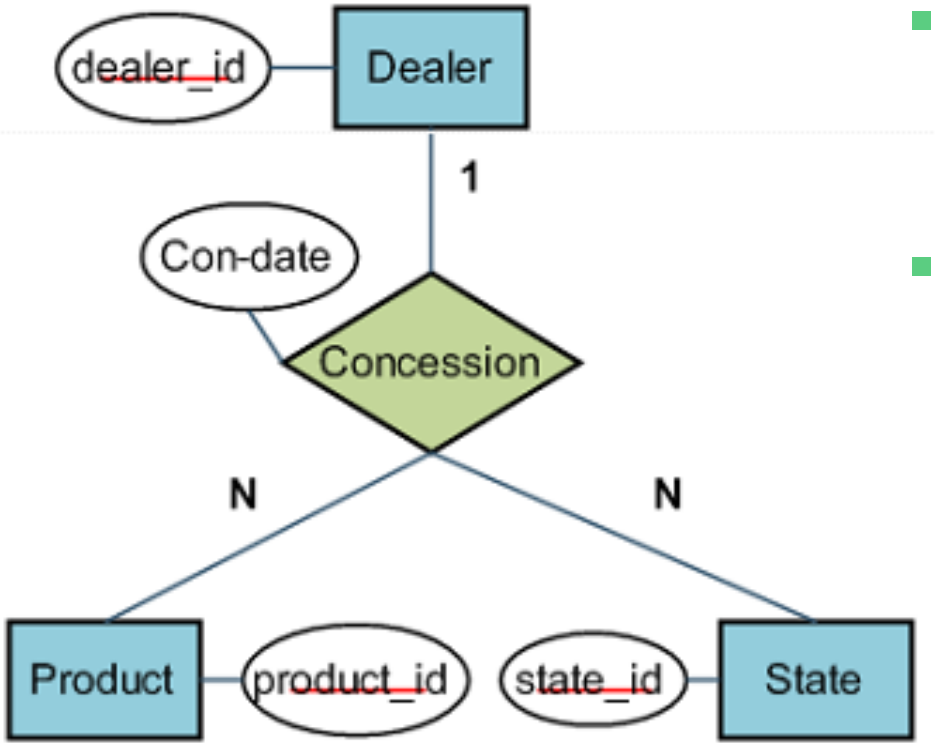
2. Example 1

Ternary relation

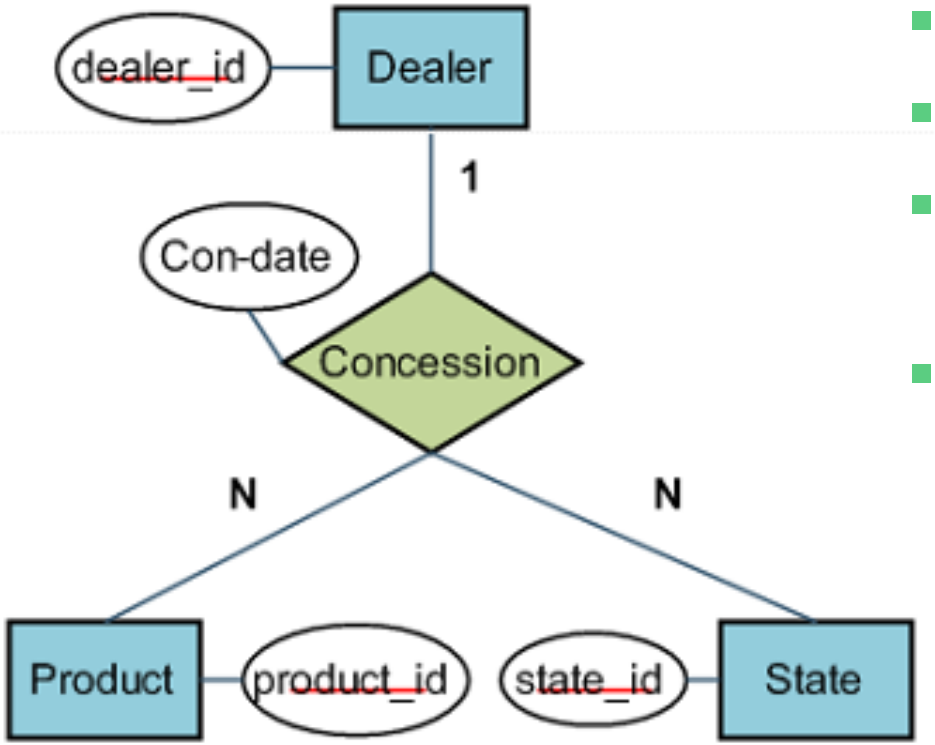


Meaning :

- *A* dealer can distribute *several* products in *several* states.
- *A* product can be sold by *many* dealers, but in each state, a product must be sold by only one dealer.

2. Example 1

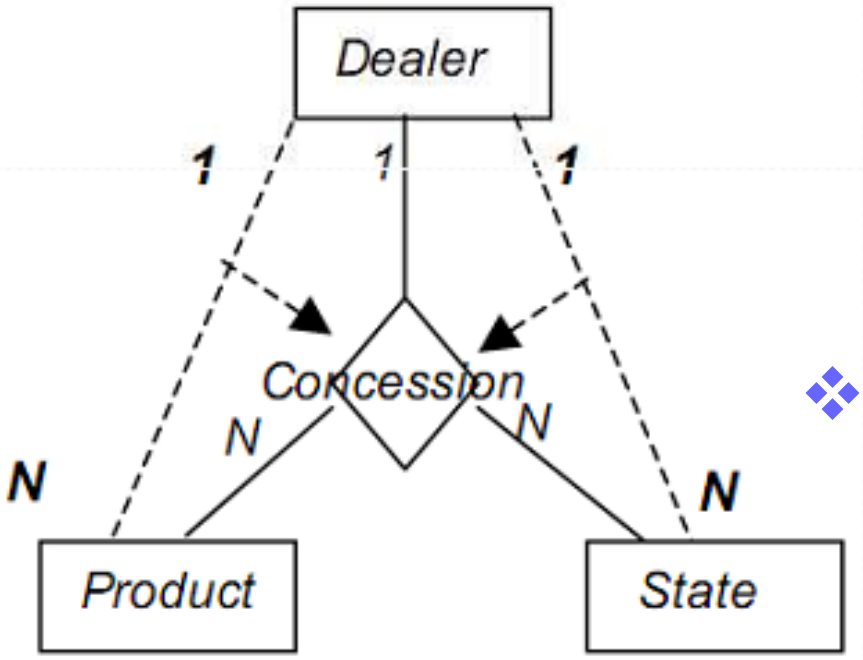
Ternary relation



Mapping:

- State(Sta-id, Sta-capital)
- Product(Pro-id, Pro-type)
- Dealer(Dea-id, Dea-address)
- Concession(Pro-id, Sta-id, Dea-id, Con-date)

2. Example 1



- **Add 2 new rules :**
  - Each product is distributed by a single dealer. (Pro-id → Dea-id)
  - Only one dealer in each state. (Sta-id → Dea-id)
- **Availabe :**
  - A product can still be sold in several states.
  - A state can be distributed several products.

2. Example 1

- **A valid set of instances :**
  - Sprite : FreeDrink (only one)
  - Kansas : FreeDrink (only one)

Pro-id	Sta-id	Dea-id	Con-date
Cocacola	Idaho	Smith&Sons	1996
Cocacola	Texas	Smith&Sons	1994
Fanta	Idaho	Smith&Sons	1994
Sprite	Kansas	FreeDrink	1998
~~Cocacola~~	~~Kansas~~	~~Smith&Sons~~	~~2000~~
~~Sprite~~	~~Idaho~~	~~Smith&Sons~~	~~2000~~

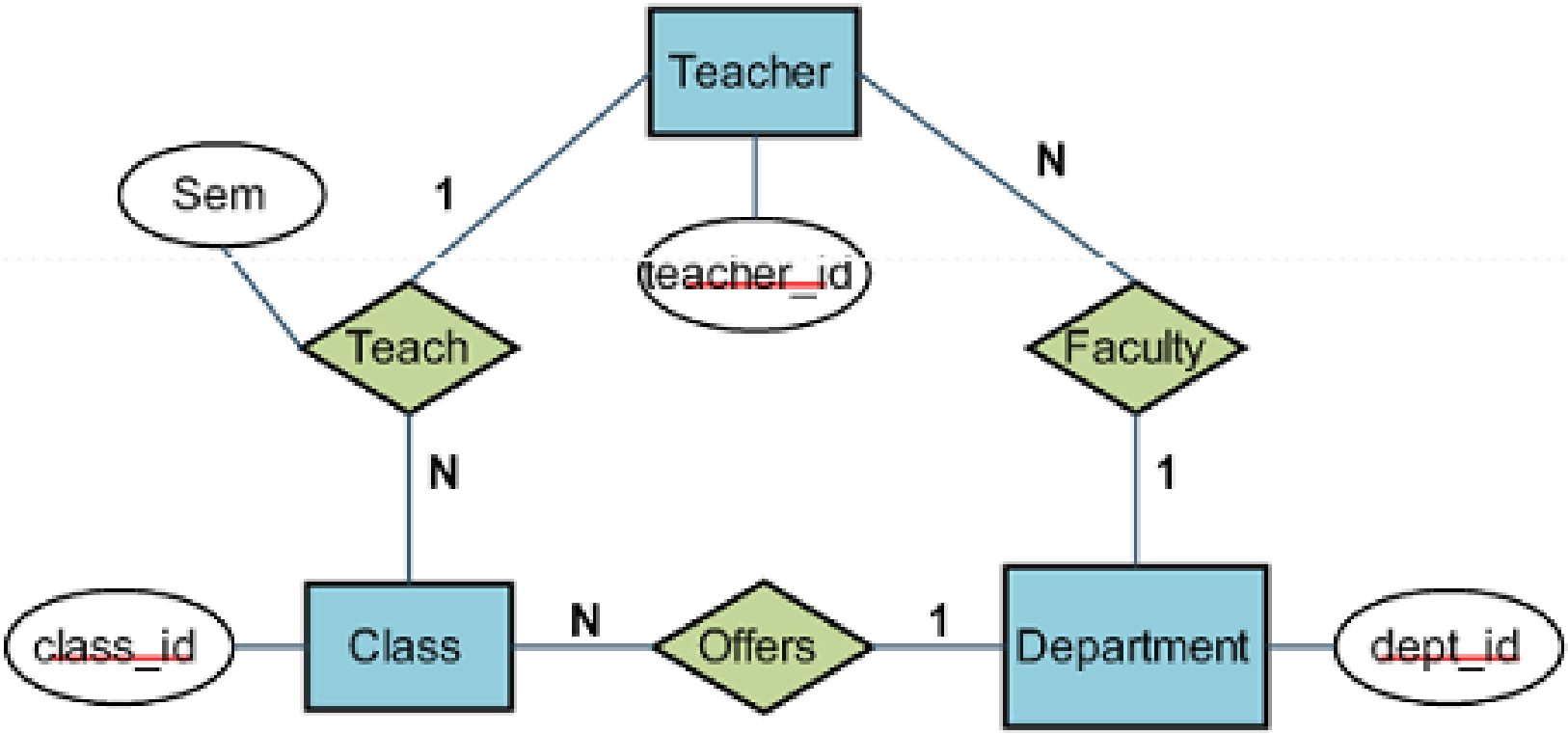
2. Example 1

- **A solution :**
  - CHECK (

```
(UNIQUE (SELECT Pro-id FROM
        (SELECT DISTINCT Pro-id, Dea-id
        FROM Concession)        )       )
AND
(UNIQUE (SELECT Sta-id FROM
        (SELECT DISTINCT Sta-id, Dea-id
        FROM Concession)        )       )
)
```

2. Example 2

❖ **An university**



2. Example 2

- **Add a rule :**
  - Teachers can only teach classes offered by department in which they are faculty.

- **Solution :**
  - NOT EXISTS (SELECT *

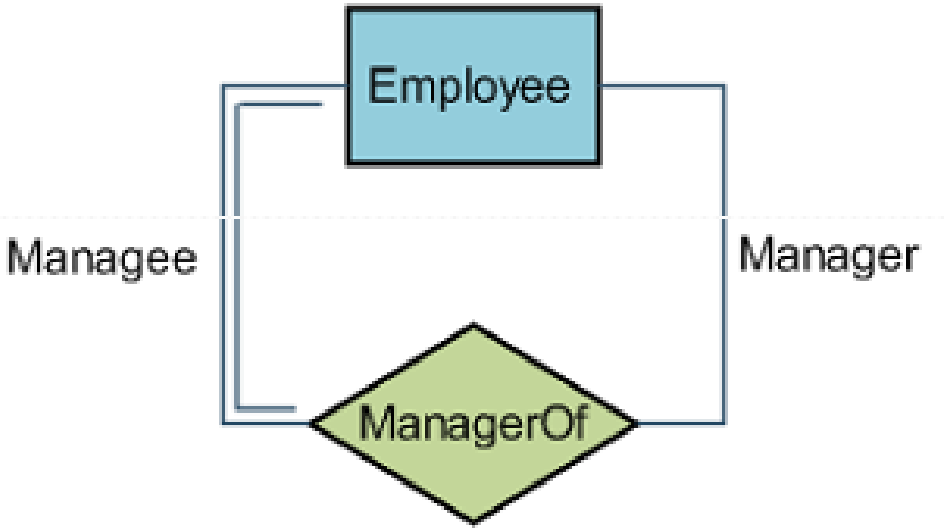
    FROM Teacher T, Class C

    WHERE T.Teacher-id = C. Teacher-id

    AND T.Dept-id <> C.Dept-id)

2. Example 3

- **Recursive relationship**



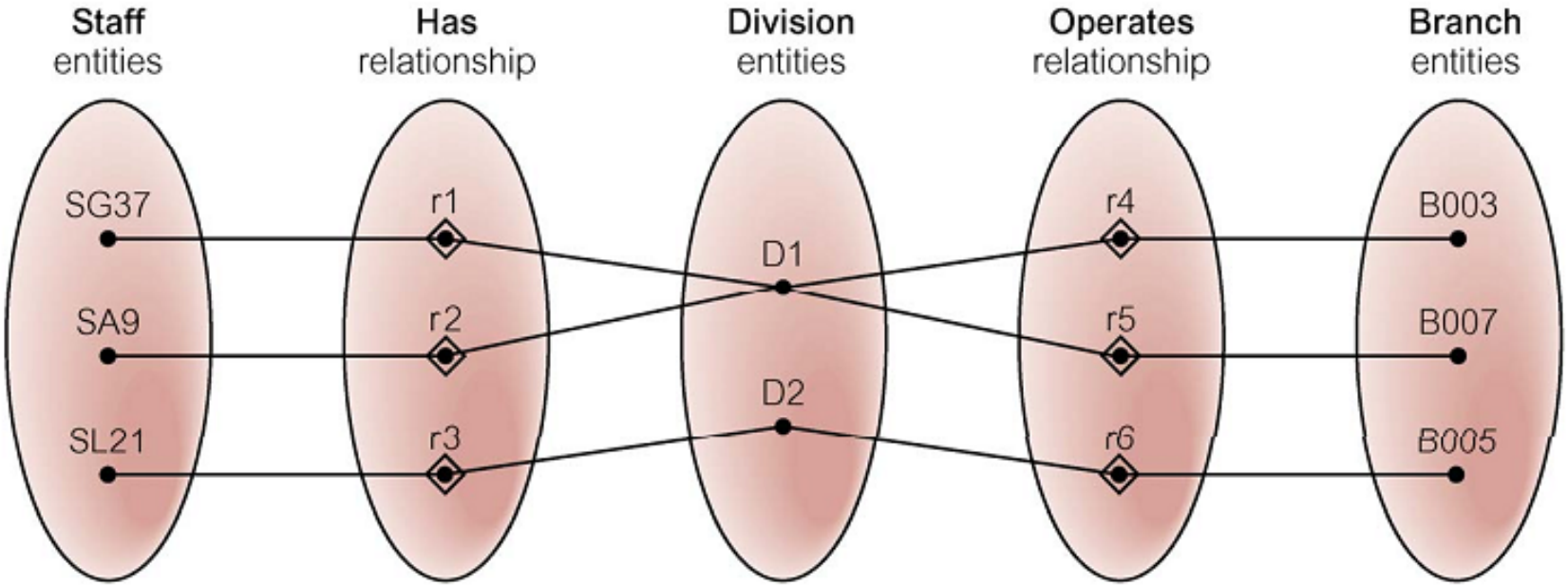
- **Rules :**
  - Not all employees are managers.
  - All employees have a manager.

2. Example 3

- **Not express :**
  - Irreflexive : no one can be his/her own manager.
  - Asymmetric : A is the manager of B, B is not the manager of A.
  - Transitive : higher-level managers.

  → Combination : no cycles in Employee.

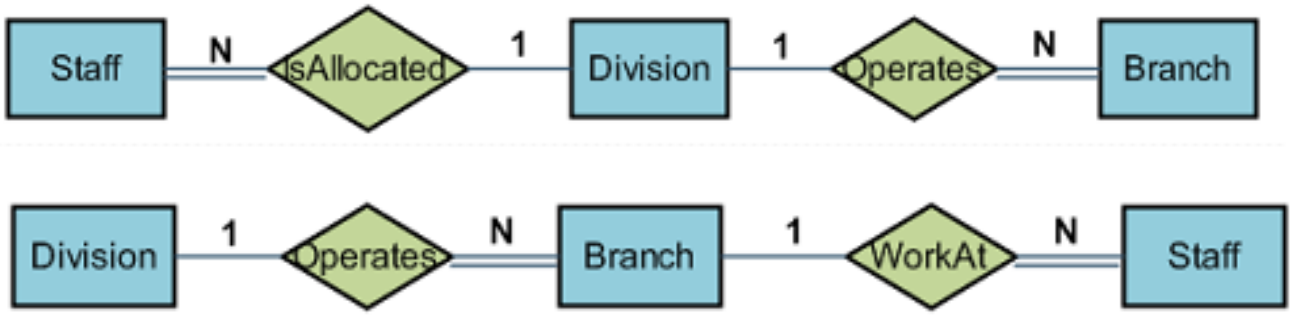
2. Example 4 (Fan trap)



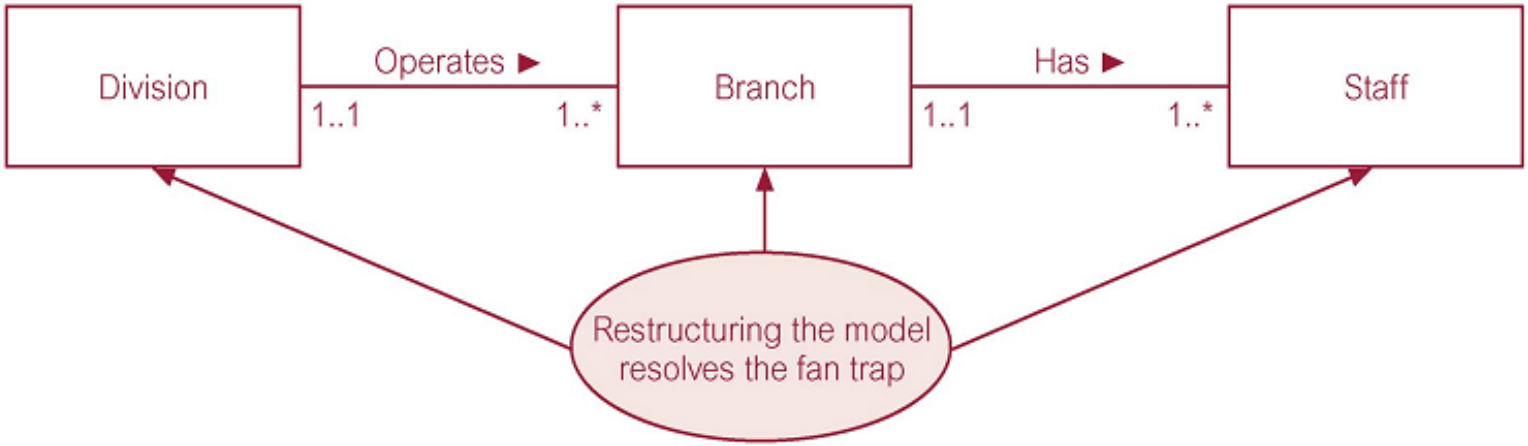
At which branch office does staff number SG37 work?

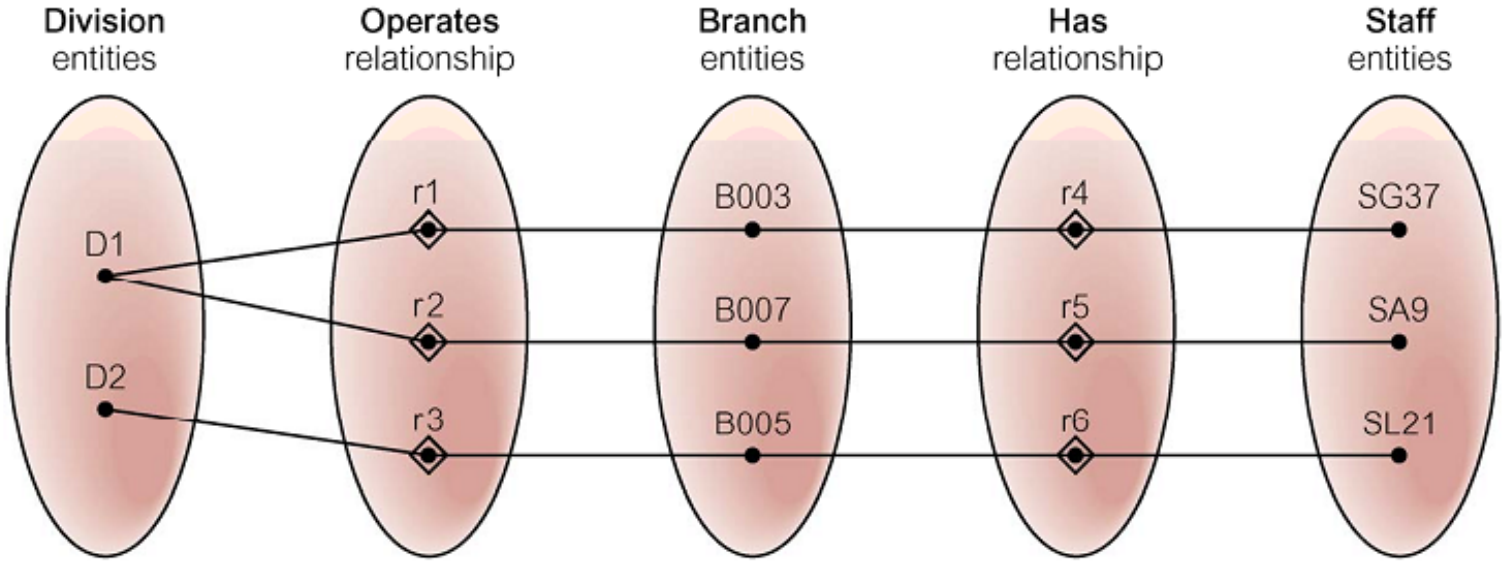
2. Example 4 (Fan trap)

- **Fan trap :**
  - Pathway between certain entity occurrences is ambiguous.
  - Two or more 1:N relationships fan out from the same entity.
- **Solution : restructuring**

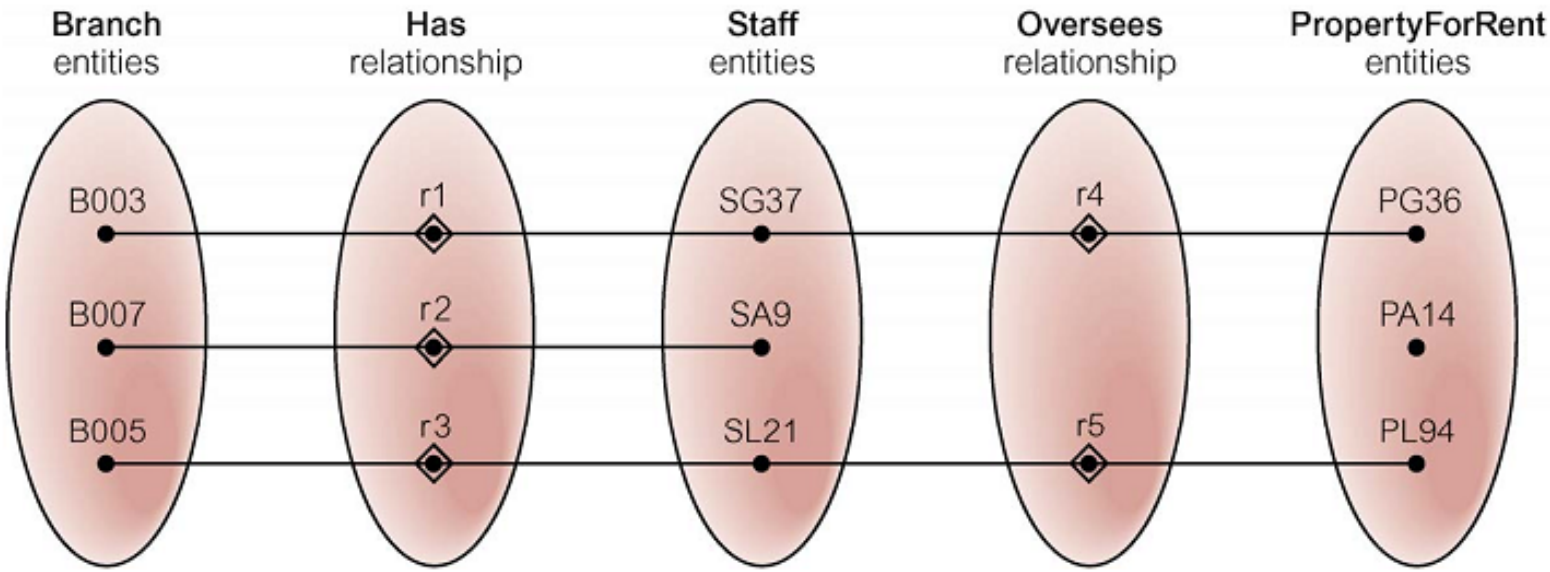


2. Example 4 (Fan trap)





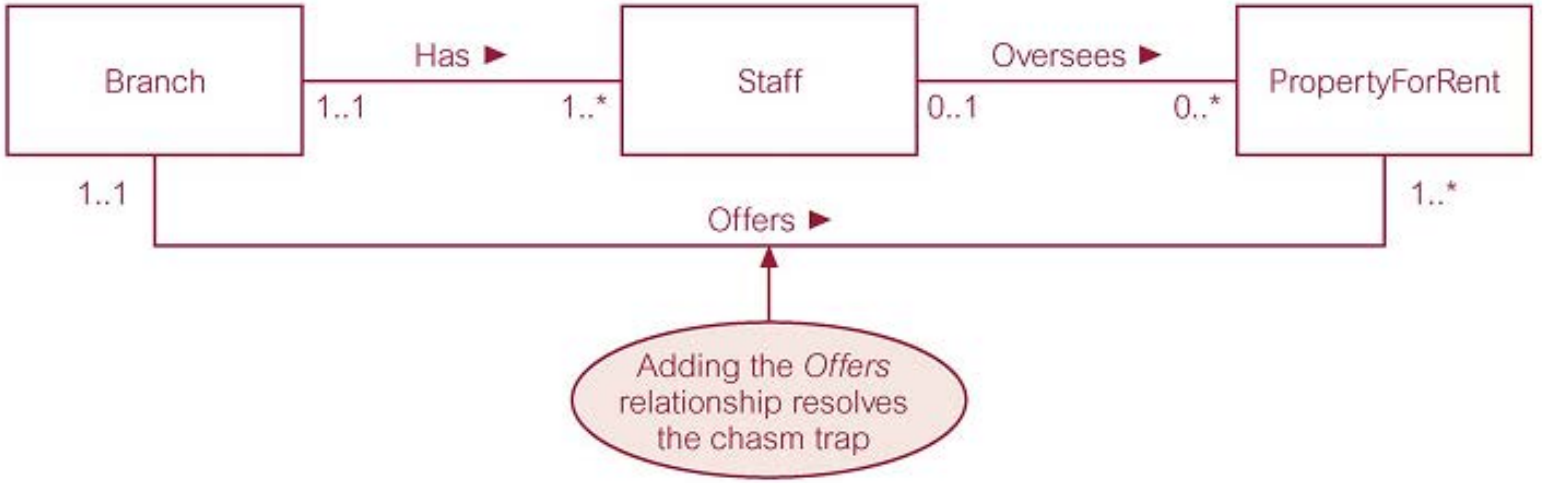
2. Example 5 (Chasm Trap)



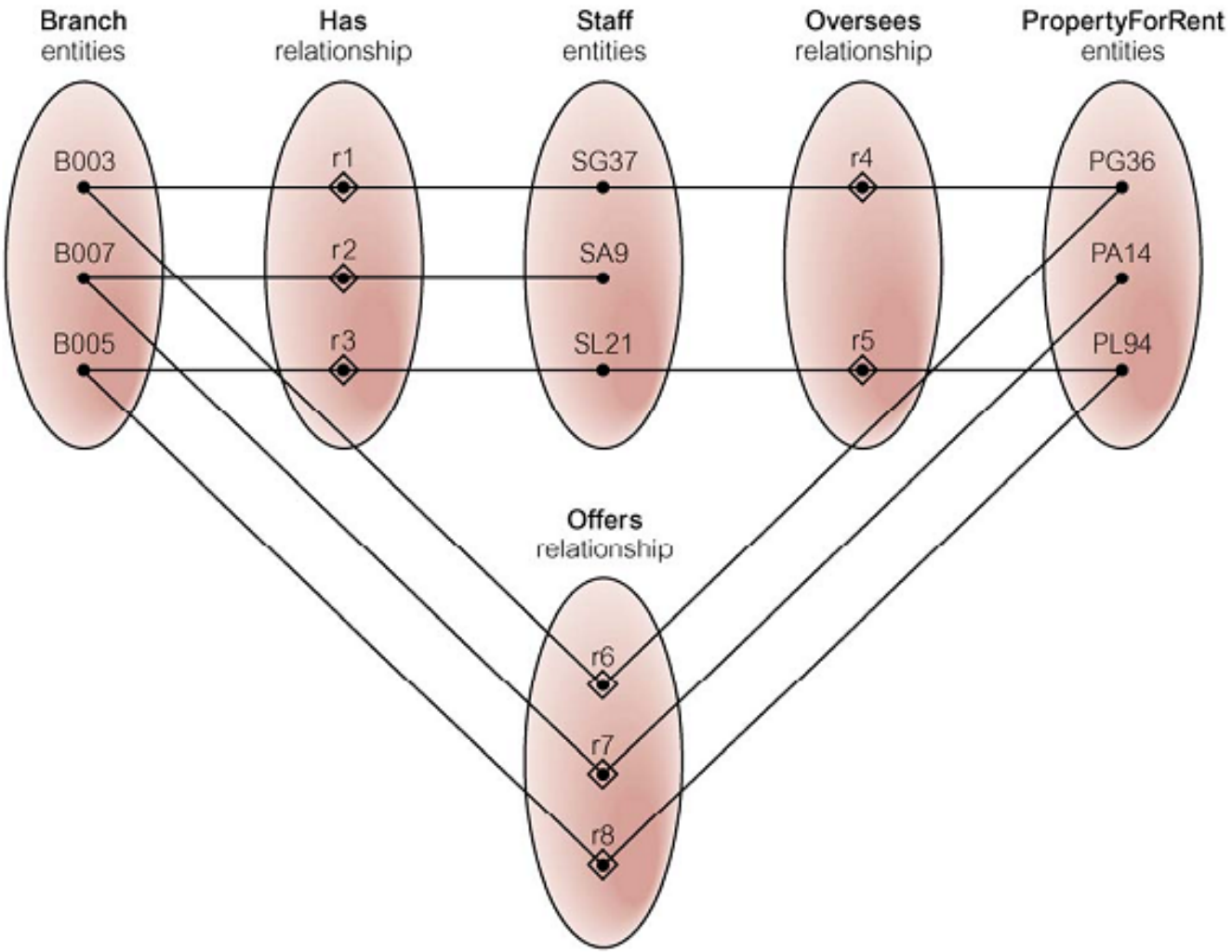
At which branch office is property PA14 available?

2. Example 5 (Chasm Trap)

- **Chasm trap :**
  - Pathway does not exist between certain entity occurrences.
- **Solution :**

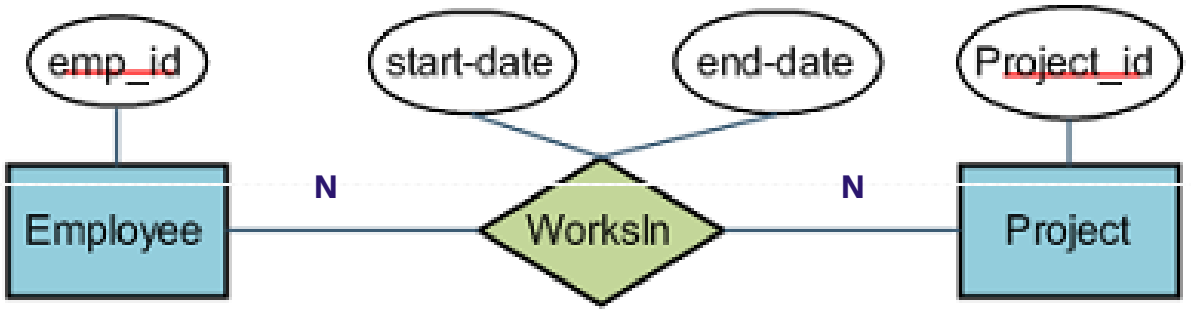


2. Example 5 (Chasm Trap)



2. Example 6

- **A Company :**



- **Rule:** an employee can't work in 2 projects at the same time.
- EMP-PROJ(emp-id, start-day, end-day, project_id)
  - FD: emp_id, start-day, end-day -> project_id

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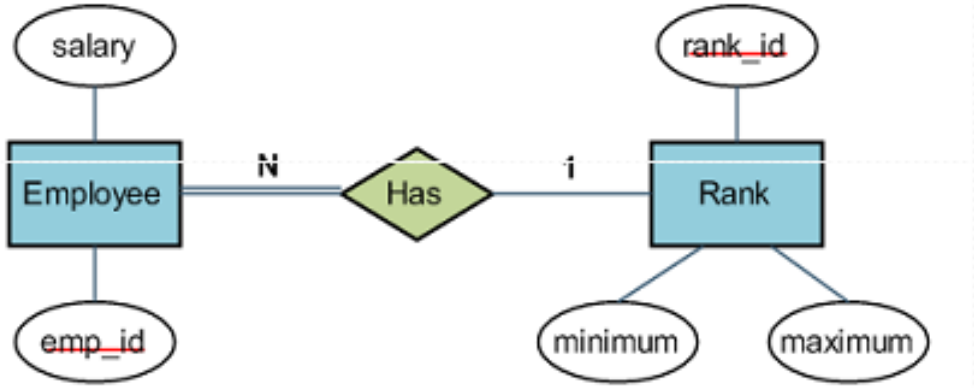
3. Attribute Constraints

- **A Company**



- **Rule : min ≤ salary ≤ max**
- **Solution :**
  - NOT EXISTS (SELECT * FROM Employee E, Rank R
    WHERE E.Rank-id = R.Rank-id
    AND (Salary < Minimum OR Salary > Maximum))

3. Attribute Constraints

- **Limit : inability to sharing information**
- **Heterogeneous information integration :**
  - 2 Restaurants : attribute “meal-cost”
    - Include taxes vs no taxes
    - US $ vs VietNam Dong
  - 2 Colleges : attribute “grade”
    - “A,B,C,D,F” vs “1-10”

4. Conclusion

- Semantics can’t be completely captured in any conceptual model.
- Database design : E-R model + requirement specification document (adding checks and assertions)

- Balance expressiveness and complexity.

References

- **Antonio Badia, *Entity-Relationship modeling Revisited*, SIGMOD Record, Vol.33, No.1 March 2004.**

- **Camps Pare, R. *From Ternary Relationships to Relational Tables: A case Against Common beliefs*, SIGMOD record, v.31, n.2 June 2002.**

Thank You !
Q&A