Weaknesses Of Entity-Relationship Model

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Outline

- Introduction
- Weaknesses of ER Model
  - Relation constrains
  - Attribute constrains
  - Another constrains
- Capturing semantics
- Conclusion

Introduction

- ER Model:
  - A basic tool in database design.
  - Very important role in Information System modeling.
  - Capturing the basic semantics of many different situation.

Outline

Introduction

- However, databases are asked to support:
  - more complex applications.
  - capturing more domain semantics is becoming a more pressing need.
- Therefore, exploring enhancements and extensions to the E-R model becomes a legitimate and important area of research.

Outline

Characteristics of E-R Models

- Basic components: *attributes, entities* and *relationships*.
- *Attribute constraints*: the information expressed by relationships on attributes.
- *Relation constraints*: the information expressed by relationships on relations.
- These two cases are not the only ones; we can have lack of information about an entity and some relationship that the entity involved with (*Other constraints*).

Outline

Relation constraints

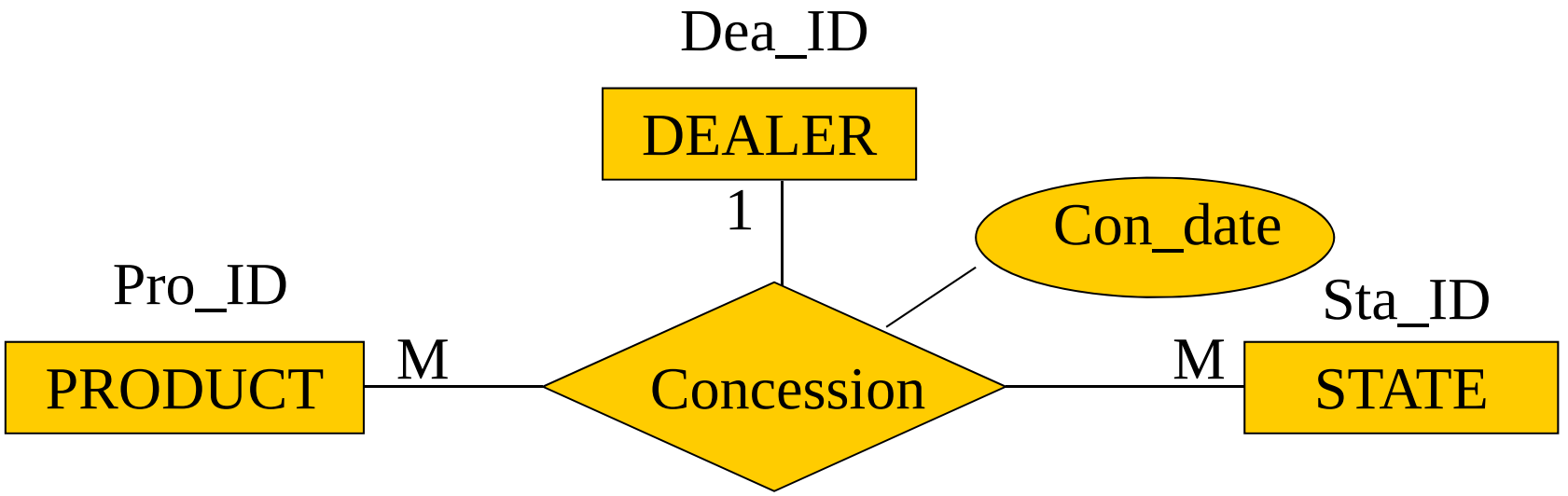
- Example 1:Ternary Relation
- Example 2:Binary Relation
- Example 3:Recursive relationship (unary)
- Example 4:Work-in Relation
- Example 5: Connection traps

Outline

Example 1: Ternary Relation

- E-R model: Concession be a ternary relation between entities *Dealer, Product* and *State*, with an attribute concession-date.
- Each product must be sold by a single Dealer in each state.
- The relationship with *Dealer* and *Product, State* is relationship 1-M.

Example 1: Ternary Relation



Example 1: Ternary Relation

- Add two rules:
  - Each product is distributed by a single dealer, regardless of state.
  - In each state, there is only one dealer.

Example 1: Ternary Relation

- A valid set of instances:

Pro_id	*Sta_id*	*Dea_id*	*Con_date*
TV21	*Ha Noi*	*LG*	*1994*
TV32	*HCM*	*Sony*	*2000*
TV32	*HP*	*Sony*	*2000*

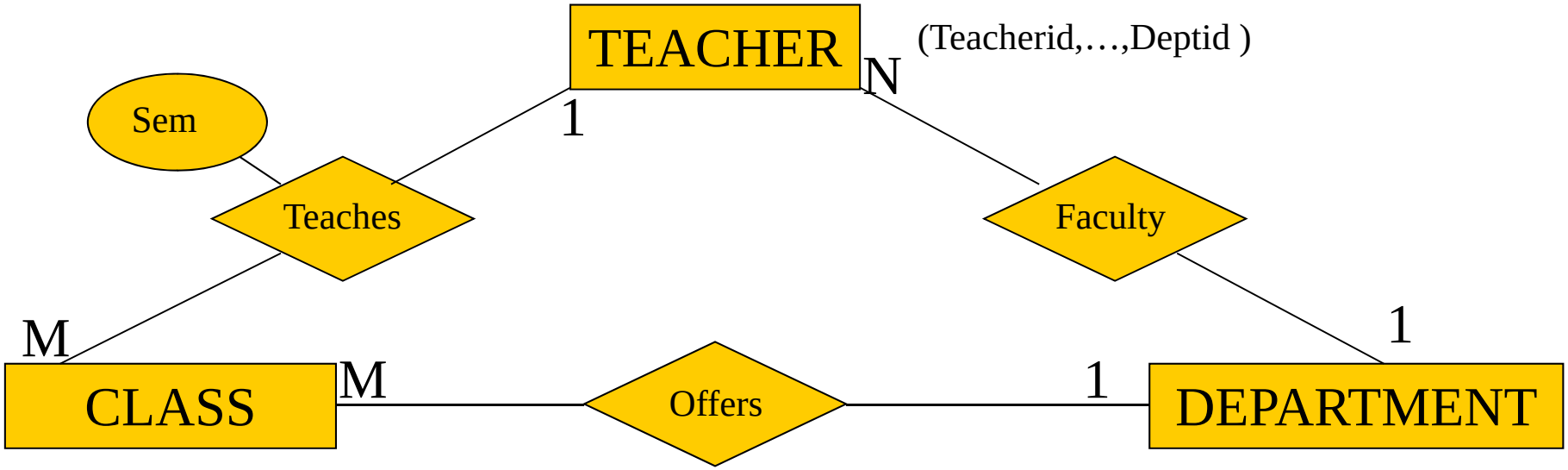
- Now it should be impossible to additionally insert the following instances:

TV42	HCM	Sam Sung	2000
TV36	HP	Panasonic	2002
TV32	Nam Dinh	Acer	2006

- E-R model can’t express these constraints

Example 2: Model for a University

- Entities: *teacher, class, department*



- The rule: teachers can only teach classes offer by the department in which they are faculty. This rule can't be enforced in the E-R model.

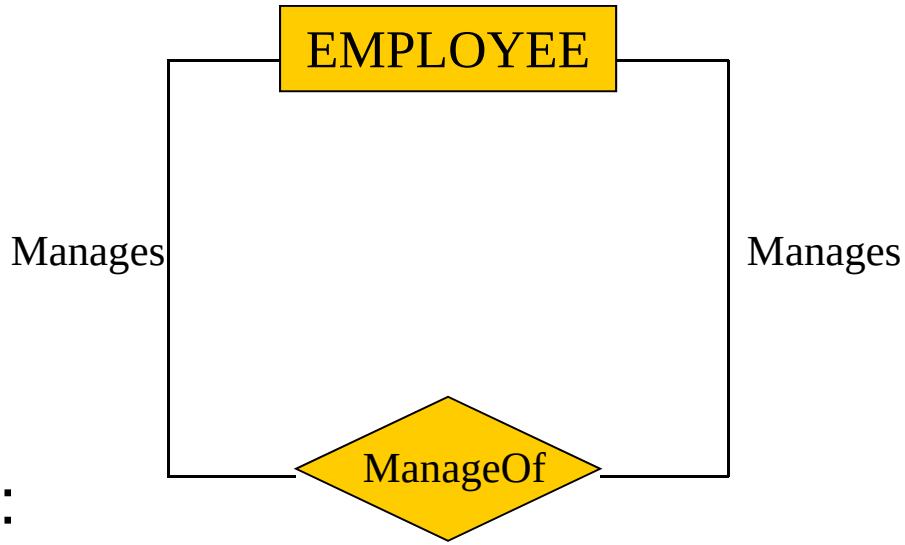
Relation Constraints

Example 2: Model for a University

- NOT EXITS (SELECT * FROM TEACHER,CLASS WHERE TEACHER.TEACHERID=CLASS TEACHERID AND TEACHER.DEPID<>CLASS.DEPID)
- If *Faculty* were many-to-many (i.e. a teacher can be faculty in more than one department), the rule becomes much harder to write in SQL.

Example 3: Recursive relationships

- Let there be a recursive relationship *ManagerOf* on an entity *Employee*



- Two rules:
  - Such relationship is partial on the manager role (not all employees are managers)
  - Total on the manage role (all employees have manager)

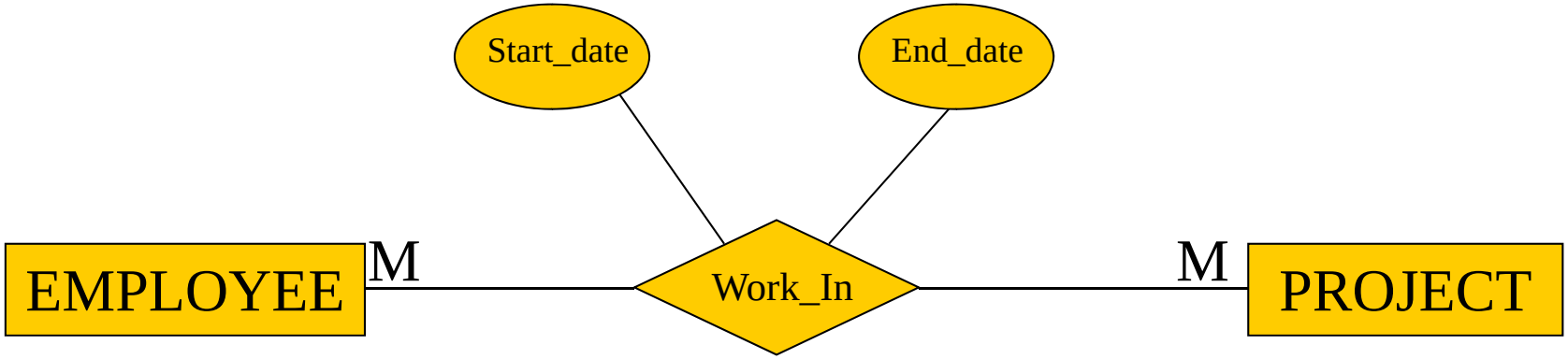
Example 3: Recursive relationships

- [WITH RECURSIVE temporary-views]
- SELECT [ALL | DISTINCT] [row-limitation] select-list
- [INTO { hostvar-list | variable-list | table-name }]
- [FROM table-expression]
- [WHERE search-condition] [GROUP BY [group-by-expression][HAVING search-condition]
- [ORDER BY { expression | integer } [ASC | DESC], ...]
- [FOR { UPDATE [cursor-concurrency] | READ ONLY }]
- ....
- **Example: Require to find the Mary's manager from table *Employee(manager,employee)***

```
WITH RECURSIVE Ancestor(anc,desc) AS
( (SELECT manager as anc, employee as desc FROM
Employee)
UNION
(SELECT Ancestor.anc, Employee.employee as desc
FROM Ancestor, Employee WHERE Ancestor.desc =
Employee.manager) )
SELECT anc FROM Ancestor WHERE desc = "Mary"
```

Example 4: Work-in Relation

- Rule: An Employee can't work in two projects at the same time (an employee must work in one project at a time)



- **Create a relationship** (*edi, start_date, end_date, pid*) **with a functional dependence** *eid,start_date,end_date -> pid*

Example 5: Connection traps

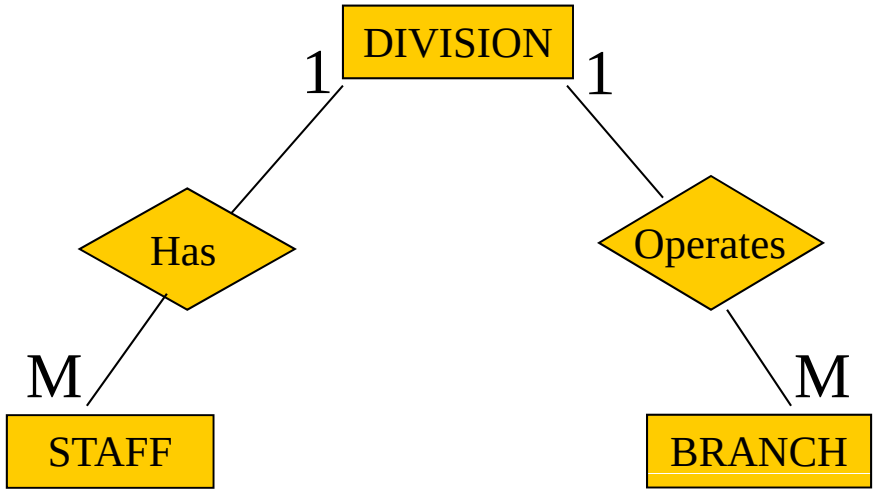
- There are several problems that may arise when designing a conceptual data model. These are known as connection traps.
- Two main types of connection traps are called *fan traps* and *chasm traps*.

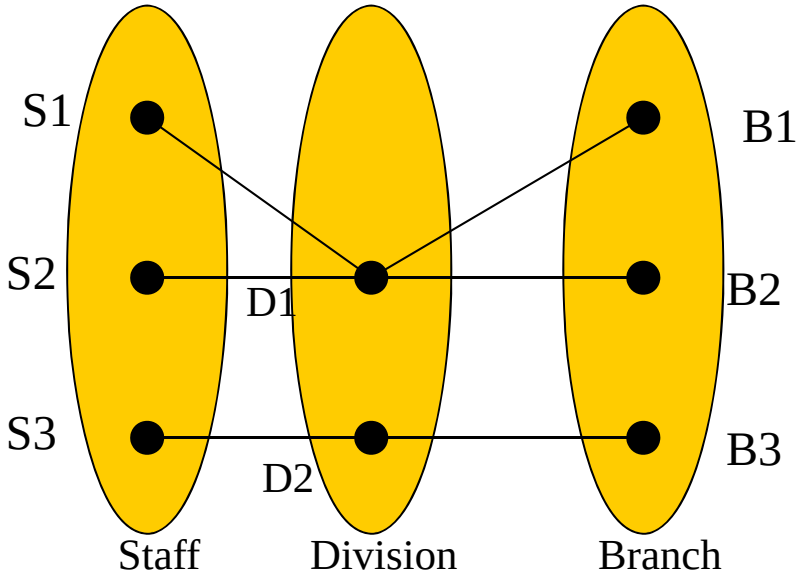
Example 5: Connection traps

- Fan traps:
  - A fan trap occurs when a model represents a relationship between entity types, but the pathway between certain entity occurrences is ambiguous. It occurs when 1:M relationships fan out from a single entity.

Example 5: Fan trap example

- Problem: Some Staff may be related to more than one branch.

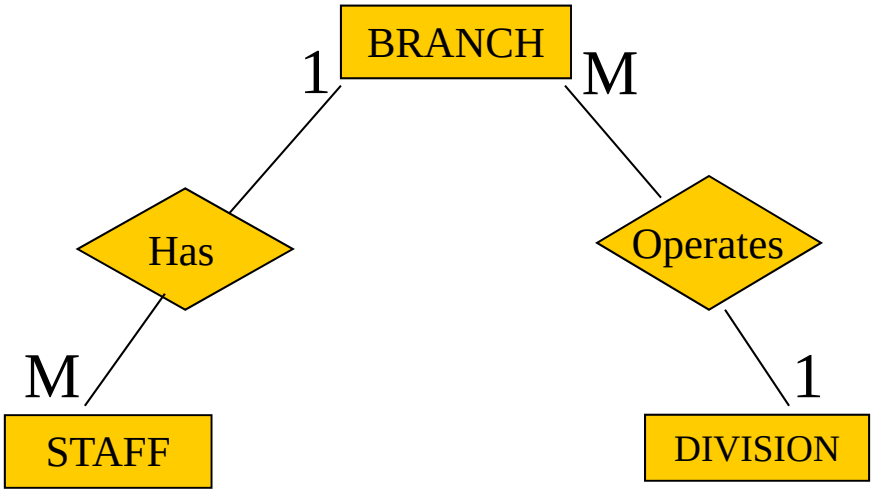


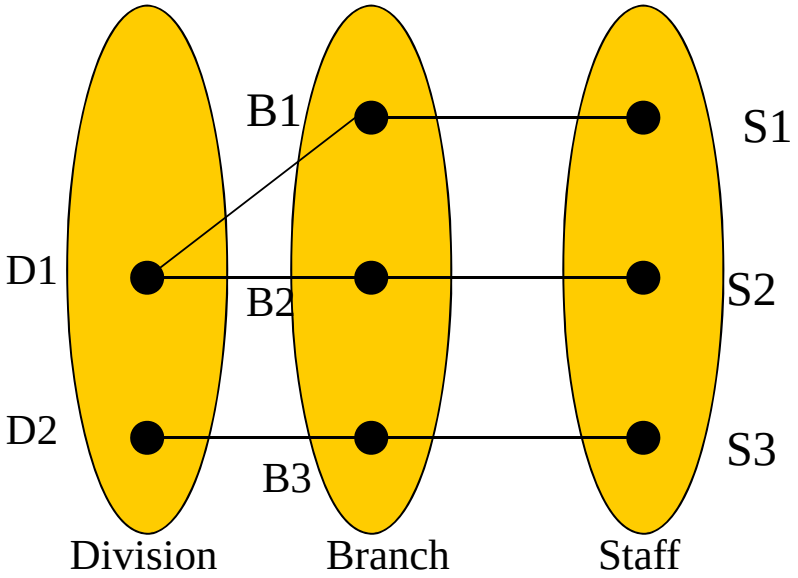


Relation Constraints

Example 5: Fan trap example

- Restructuring E-R Model





- At which branch does staff number S1 work? (B1)

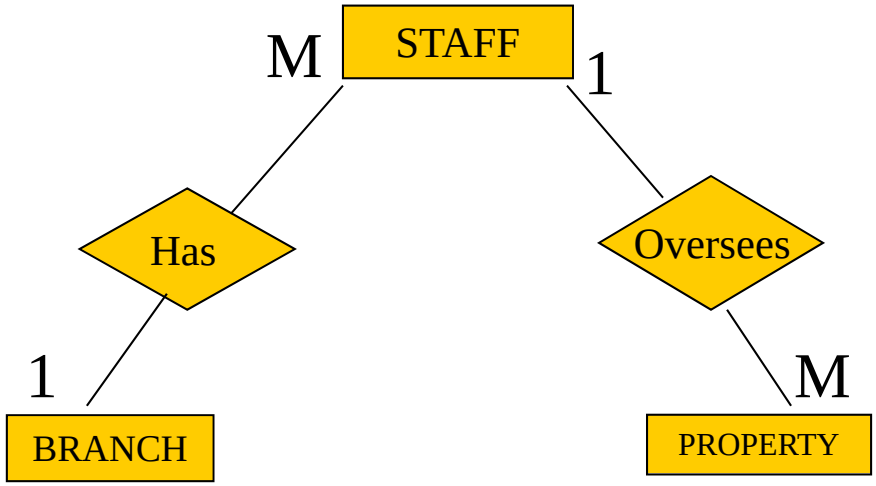
Relation Constraints

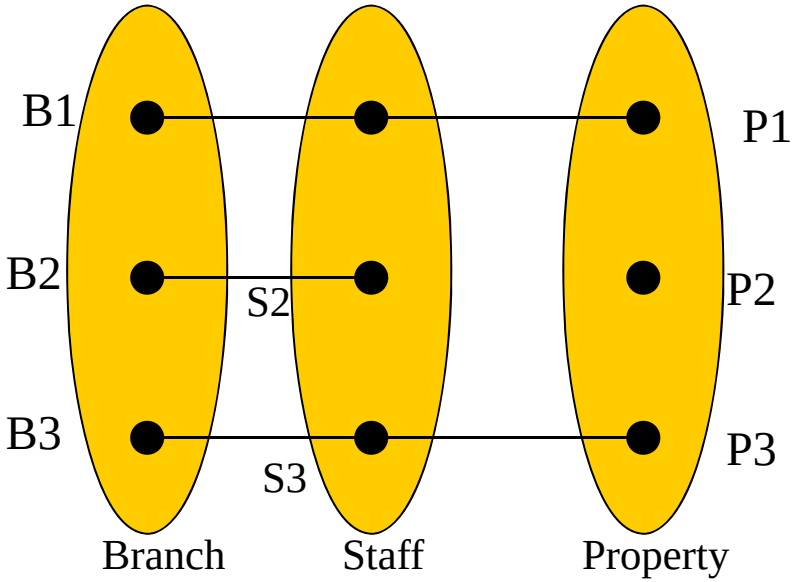
Example 5: Connection traps

- Chasm traps:
  - A chasm trap occurs when a model suggests the existence of a relationship between entity types, but the pathway does not exits between certain entity occurrences.

Example 5: Chasm trap example

- Problem: Property must be available at a branch.



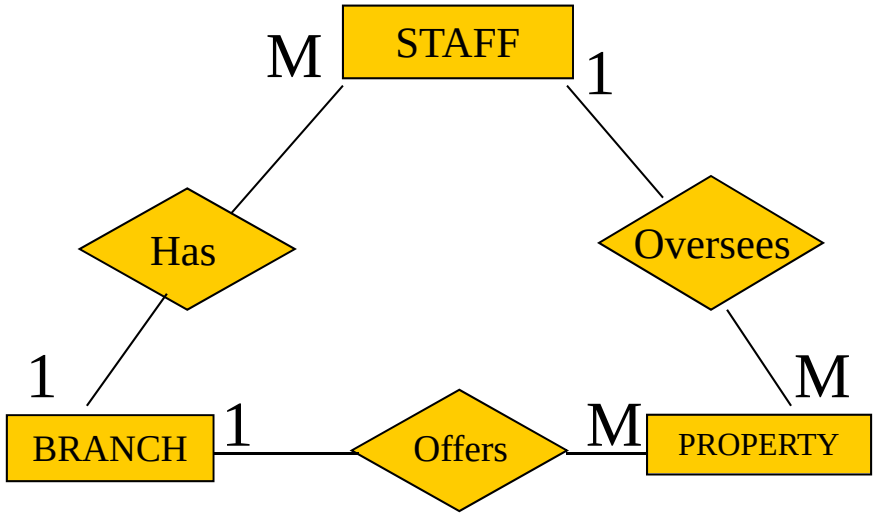


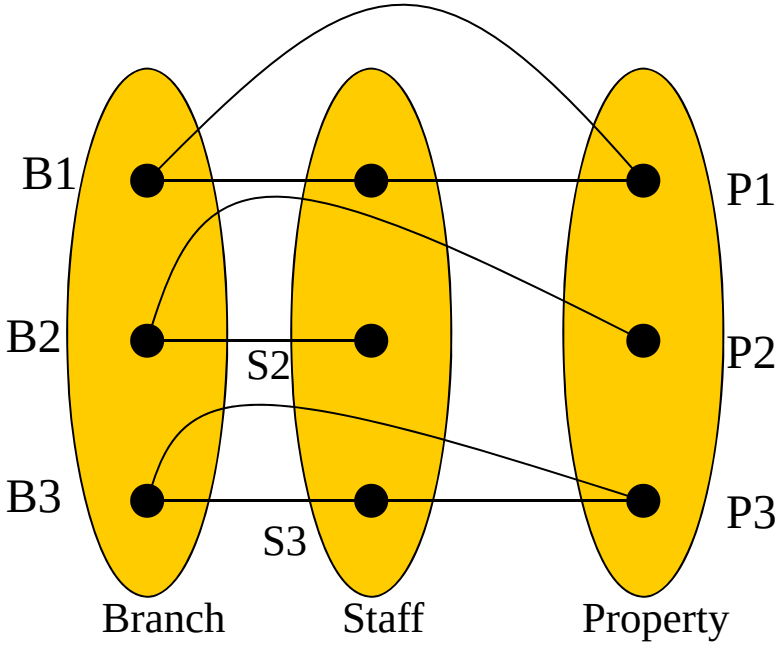
- At which branch is property number P2 available?

Relation Constraints

Example 5: Chasm trap example

- Identify the missing relationship





- At which branch is property number P2 available? (B2)

Relation Constraints

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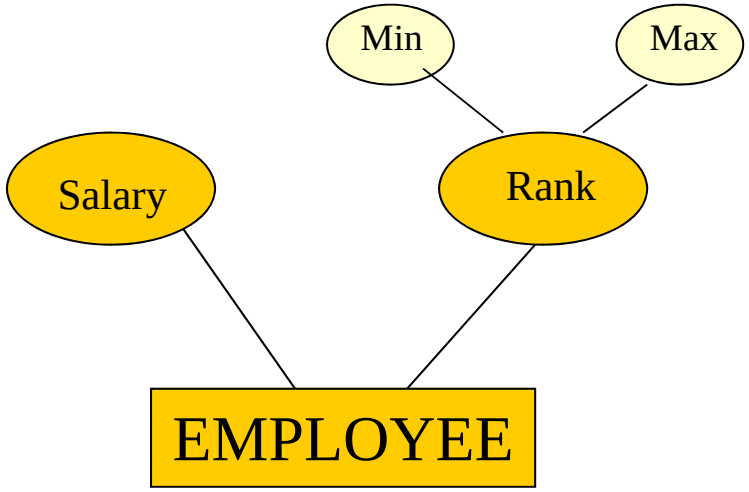
Attribute Contraints

- Example: Model for a company



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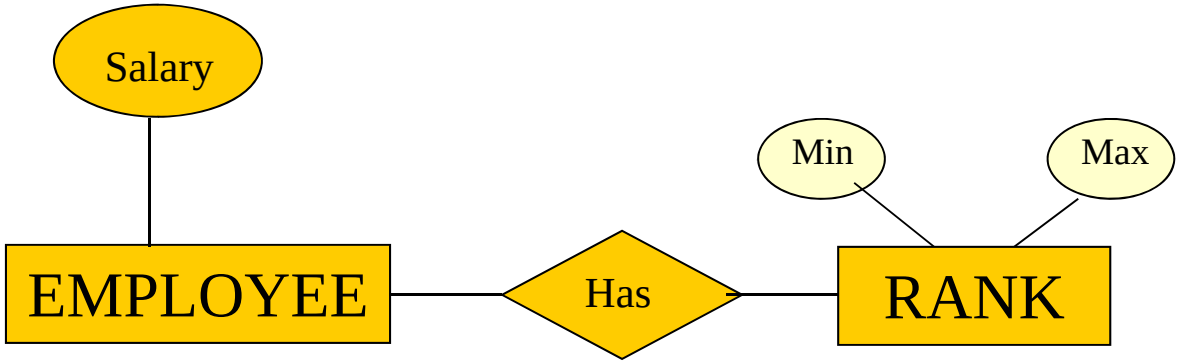
Example: Model for a company

- Rule: the salary should be within the range: Range.Min<=Salary<=Range.Max
- *Employee(employeeid,rankid,salary,..)*
- *Rank(rankid,maximum,minimum,..)*



Outline

Example: Model for a company

- Checks or Assertions
  - NOT EXISTS (SELECT * FROM EMPLOYEE, RANK WHERE EMPLOYEE.RANKID=RANK.RANKID AND (SALARY<MINIMUM OR SALARY>MAXIMUM))

Outline

Effect and Approach

- Limitations of database systems: inability of sharing data.
- This problem has been studied in the field of heterogeneous information integration.
- Example:
  - Databases with information about *restaurants* that are to be integrated. Both have a table *restaurant* with an attribute *meal-cost*. However, taxes, price are different.
  - Database about *Colleges*. Both have a table *student* with attribute *grade*.

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Effect and Approach

- Approach: analyze the semantics of attributes, given a set of metadata(ex:relationships between attributes)->This is a very complex task

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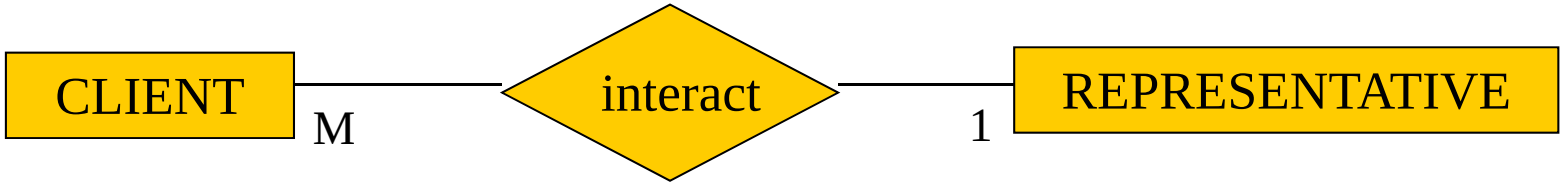
Other contraints

- Other example:



- Rule: All representatives must have the same number of clients

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Capturing semantic

- Should the use of checks and assertions be considered an intrinsic part of relational design?

Outline

Capturing semantic

- The limitation of E-R model are an expected trade-off for their ease of use, intuitive appeal and clear semantics.

->E-R models capture enough semantics to guarantee a good relational design

Outline

Capturing semantic

- E-R model is only one tool in Requirement Specification phase
- Requirement Specification Document together with the E-R model, should be taken into a account when designing the database.

Outline

Conclusion

- E-R model are widely used because of their simplicity, intuitive appeal and ability to capture useful semantics across many different domains.
- For more complex and sophisticated applications: need to capture more domain semantics is growing

Outline

Conclusion

- Possible avenues of research?
  - Develop and add constructs relationships, and attributes over attributes (and relationships over attributes)

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