Database Systems

Lecture #06

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Objectives

- To learn relational database design
  - ER model to relational model mapping

Outline

- Relational Database Design by ER-to-Relational Mapping
  - Mapping Entity Types
  - Mapping Attributes
  - Mapping Relationship Types
- Case Study

Relational Database Design by ER-to-Relational Mapping

- Design a relational database schema
  - Based on the result of conceptual design
- Mapping ER model to relational model

Mapping of Regular Entity Types

- Map each regular entity type as a relation
  - Called *entity relations*
- Attributes
  - All simple attributes of the entity type
- Primary key
  - Choose one from key attributes of the entity type

Mapping of Weak Entity Types

- Map each weak entity type as a relation
- Attributes
  - All simple attributes of the entity type
  - Primary key attribute of the owner as a foreign key
- Primary key
  - Choose one from key attributes of the entity type
  - Combine it with the foreign key attribute

Mapping of Multivalued Attributes

- Map each multivalued attribute as a new relation
- Attributes
  - Multivalued attributes
  - Key attributes of the entity type relation as FK
- Primary key
  - Combination of all attributes
    - Multivalued attributes + FK

Mapping of Composite Attributes

- Map each composite attribute as a new relation
- Attributes
  - Simple attributes from the component attributes
  - Key attributes of the entity type relation as foreign key
- Primary key
  - Foreign key

Mapping of Composite Attributes

- Alternative approach
  - Add all simple component attributes to the corresponding relation of the entity type

Mapping of Binary 1:1 Relationship Types

- Identify relations that correspond to entity types participating in the relationship type

foreign key approach

- Choose one of the relations and include the *PK of the other one* as the FK
  - Better to choose an entity type with *total participation*
- Include simple attributes of 1:1 relationship type as attributes of the relation

Mapping of Binary 1:*N* Relationship Types

- Identify relation that represents participating entity type at *N*-side of relationship type
- Include *PK of the other entity type* as FK
- Include simple attributes of 1:*N* relationship type as attributes of the relation

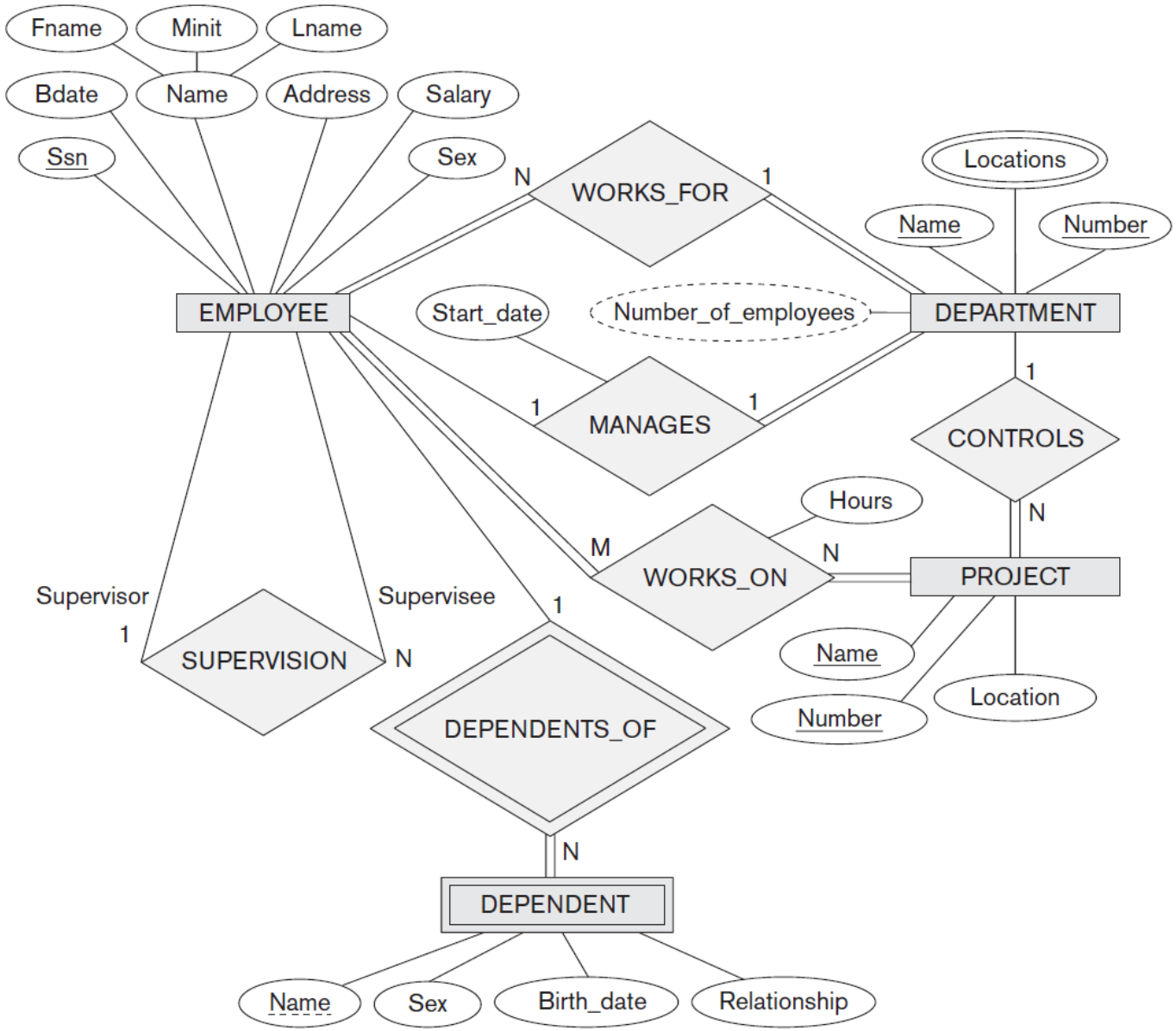
Mapping of Binary *M*:*N* Relationship Types

- Map each *M*:*N* relationship type as an *independent relation*
- Attributes
  - PK of both participating entity types as FK
  - Simple attributes of the relationship type
- Primary key
  - Combination of all the foreign keys

Mapping of *N*-ary Relationship Types

- Map each *N-ary* relationship type as a relation
- Attributes
  - PK of participating entity types as FK
  - Simple attributes of the relationship type
- Primary key
  - Combination of all foreign keys

COMPANY Database Example



COMPANY Database Example

- Mapping of regular entity types
  - EMPLOYEE
    - Create a new relation EMPLOYEE
    - Include simple attributes
      - **Ssn**, **Bdate**, **Address**, **Sex**, **Salary**
    - Set **Ssn** as PK

COMPANY Database Example

- Mapping of regular entity types
  - DEPARTMENT
    - Create a new relation DEPARTMENT
    - Include simple attributes
      - **Name** as **Dname**, **Number** as **Dnumber**
    - Set **Dnumber** as PK

COMPANY Database Example

- Mapping of regular entity types
  - PROJECT
    - Create a new relation PROJECT
    - Include simple attributes
      - **Name** as **Pname**, **Number** as **Pnumber**, **Location** as **Plocation**
    - Set **Pnumber** as PK

COMPANY Database Example

- Mapping of weak entity types
  - DEPENDENT
    - Create a new relation DEPENDENT
    - Include simple attributes
      - **Name** as **Dependent_name**, **Sex**, **Birth_date** as **Bdate**, **Relationship**
    - Include PK of the owner entity type
      - **Ssn** as **Essn**
    - Set **Essn** + **Dependent_name** as PK

COMPANY Database Example

- Mapping of multivalued attributes
  - **Locations** in DEPARTMENT
    - Create a new relation DEPT_LOCATIONS
    - Include PK of DEPARTMENT as FK
      - **Dnumber**
    - Include multivalued attribute
      - **Locations** as **Dlocation**
    - Set **Dnumber** + **Dlocation** as PK

COMPANY Database Example

- Mapping of composite attributes
  - EMPLOYEE
    - Include simple attributes from the composite attribute **Name**
      - **Fname**, **Minit**, **Lname**

COMPANY Database Example

- Mapping of binary 1:1 relationship types
  - MANAGES
    - DEPARTMENT is *total participation*
    - Include PK of EMPLOYEE as FK of DEPARTMENT
      - **Ssn** as **Mgr_ssn**
    - Include simple attributes of MANAGES
      - **Start_date** as **Mgr_start_date**

COMPANY Database Example

- Mapping of binary 1:*N* relationship types
  - WORKS_FOR
    - EMPLOYEE is *N-side entity type*
    - Include PK of DEPARTMENT as FK of EMPLOYEE
      - **Dnumber** as **Dno**

COMPANY Database Example

- Mapping of binary 1:*N* relationship types
  - CONTROLS
    - PROJECT is *N-side entity type*
    - Include PK of DEPARTMENT as FK of PROJECT
      - **Dnumber** as **Dnum**

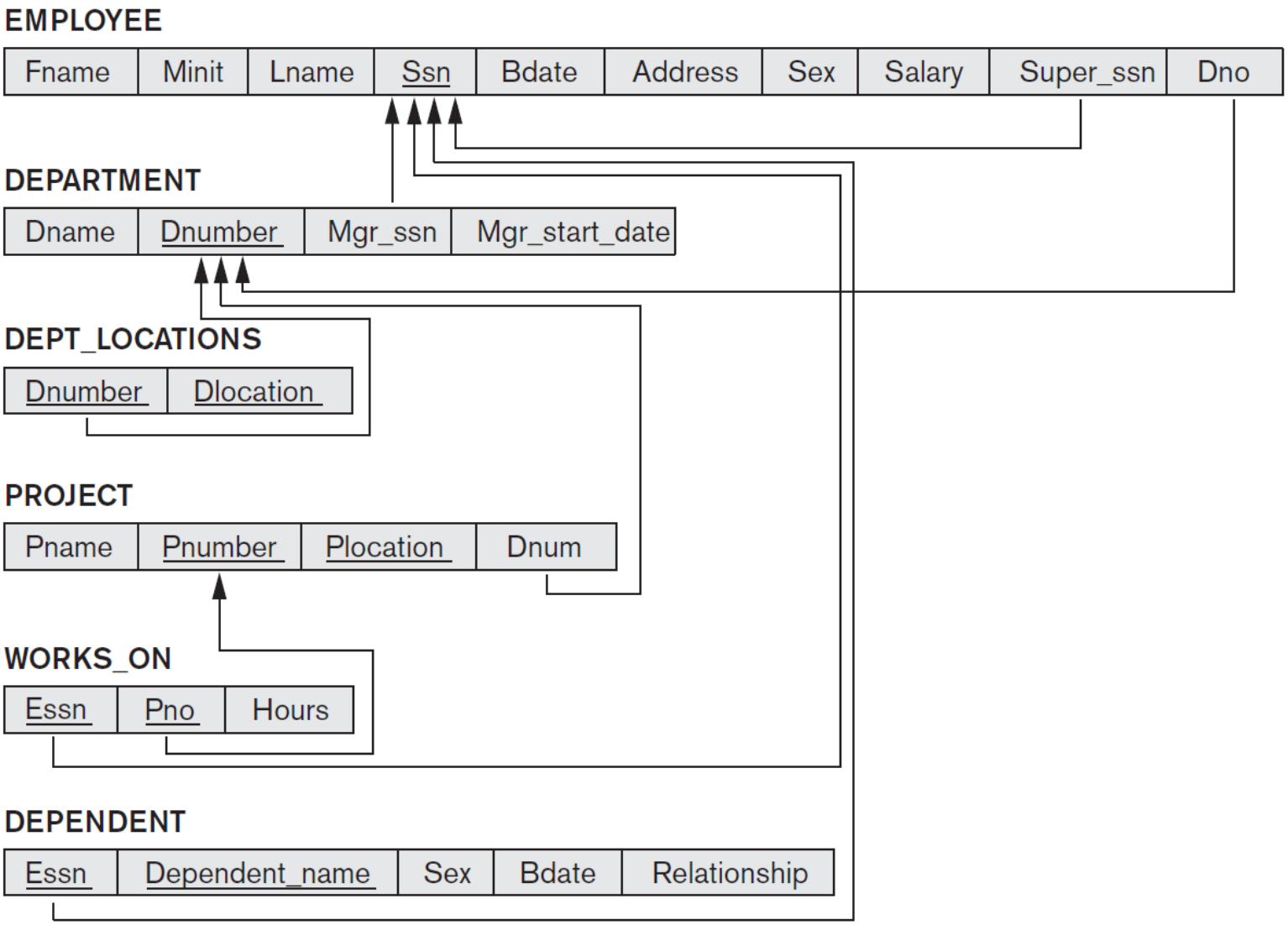
COMPANY Database Example

- Mapping of binary 1:*N* relationship types
  - SUPERVISION
    - Both sides (Supervisor, Supervisee) are EMPLOYEE
    - Include PK of EMPLOYEE as FK of EMPLOYEE
      - **Ssn** as **Super_ssn**

COMPANY Database Example

- Mapping of binary *M*:*N* relationship types
  - WORKS_ON
    - Create a *new relation WORKS_ON*
    - Include PK of EMPLOYEE and PROJECT
      - **Ssn** as **Essn**, **Pnumber** as **Pno**
    - Include simple attributes of WORKS_ON
      - **Hours**
    - Set **Essn** + **Pno** as PK

COMPANY Database Example



Summary

- Map conceptual schema design from the ER schema to a relational database schema
  - Algorithm for ER-to-relational mapping
  - Illustrated by examples from the COMPANY database

References

1. Chen, Peter Pin-Shan. "The entity-relationship model—toward a unified view of data." *ACM Transactions on Database Systems (TODS)* 1.1 (1976): 9-36.
2. Batini, Carlo, Stefano Ceri, and S. Navathe. *Entity Relationship Approach*. Elsevier Science Publishers BV (North Holland), 1989.

Have a nice day!