ENSF 608:
Entity-Relationship (ER) Modelling and Enhanced Entity-Relationship Modelling

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Refining the Initial Design by Introducing Relationships

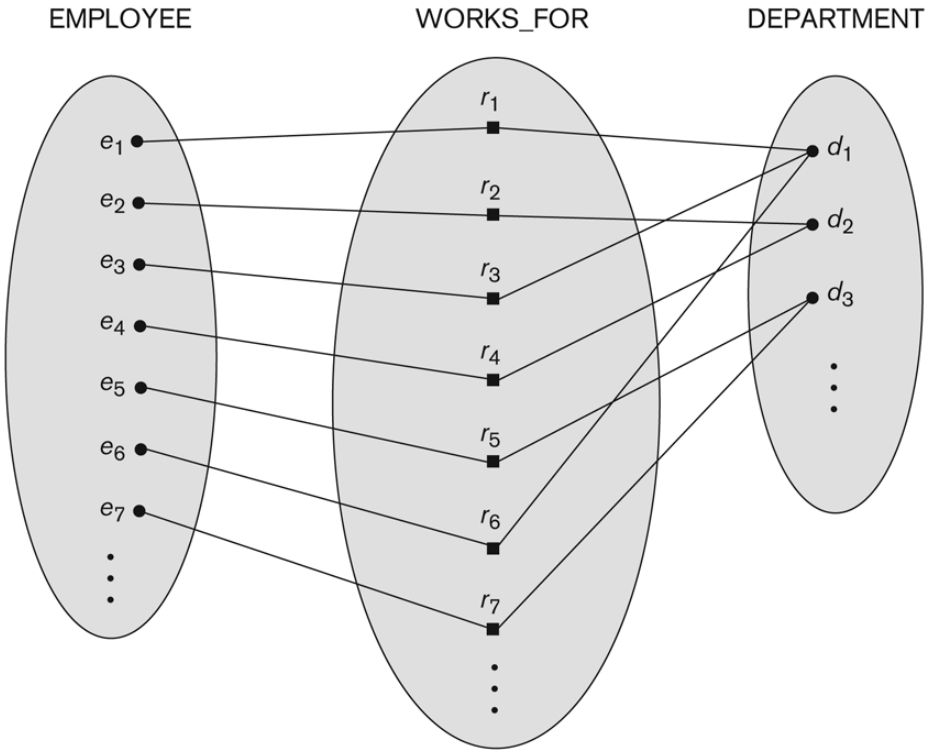
- The initial design is typically not complete
- Some aspects in the requirements will be represented as **relationships**
- ER model has three main concepts:
  - Entities (and their entity types and entity sets)
  - Attributes (simple, composite, multivalued)
  - Relationships (and their relationship types and relationship sets)
- We introduce relationship concepts next

Relationships and Relationship Types

- A **relationship** relates two or more distinct entities with a specific meaning.
  - For example, EMPLOYEE John Smith **works on** the ProductX Project, or EMPLOYEE Franklin Wong **manages** the Research DEPARTMENT.
- Relationships of the same type are grouped or typed into a **relationship type**.
  - For example, the WORKS_ON relationship type in which EMPLOYEEs and PROJECTs participate, or the MANAGES relationship type in which EMPLOYEEs and DEPARTMENTs participate.
- The degree of a relationship type is the number of participating entity types.
  - Both MANAGERS and WORKS_ON are **binary** relationships.

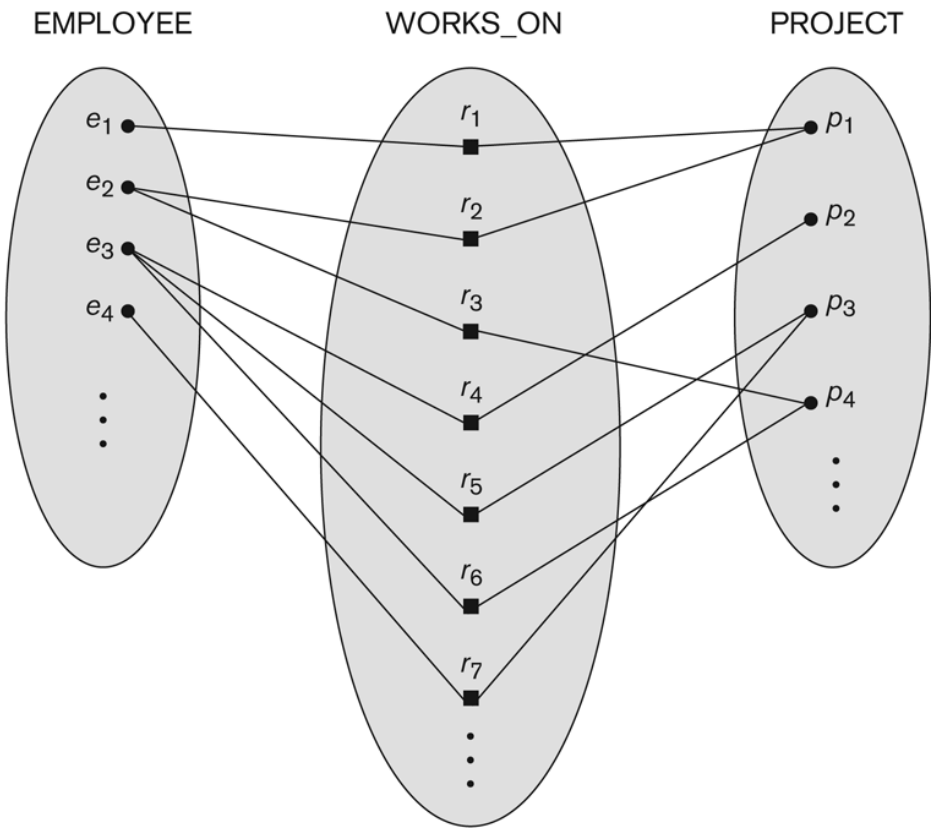
Relationship Instances of the WORKS_FOR N:1 relationship between EMPLOYEE and DEPARTMENT

Figure 3.9 Some instances in the WORKS_FOR relationship set, which represents a relationship type WORKS_FOR between EMPLOYEE and DEPARTMENT



Relationship Instances of the M:N WORKS_ON Relationship between EMPLOYEE and PROJECT

Figure 3.13 An M:N relationship, WORKS_ON.



Relationship Type Vs Relationship Set (1 of 2)

- Relationship Type:
  - Is the schema description of a relationship
  - Identifies the relationship name and the participating entity types
  - Also identifies certain relationship constraints
- Relationship Set:
  - The current set of relationship instances represented in the database
  - The current **state** of a relationship type

Relationship Type Vs Relationship Set (2 of 2)

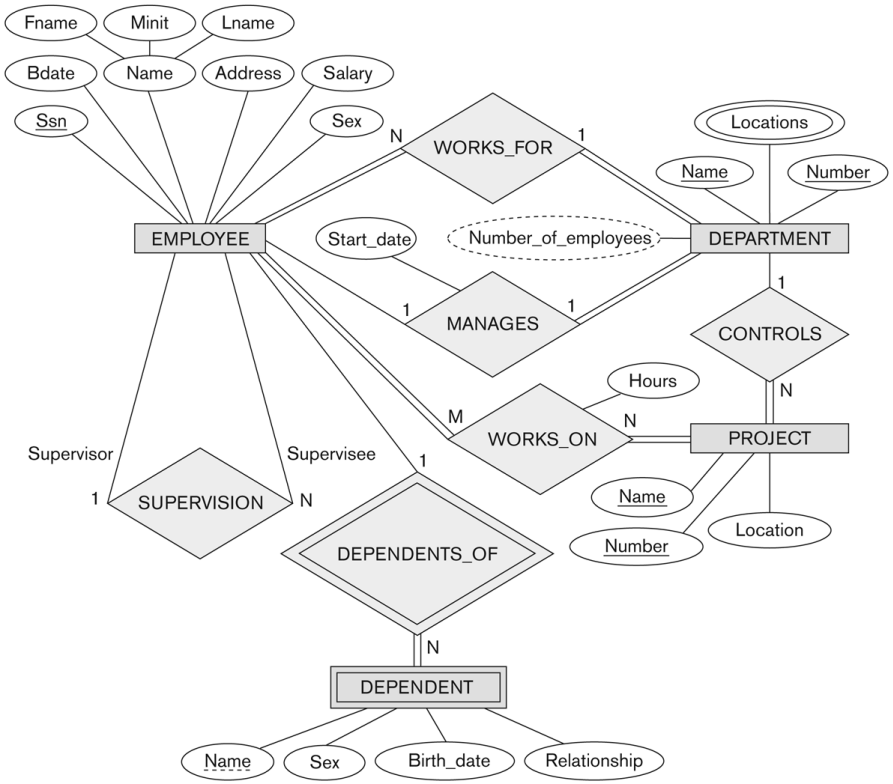
- Previous figures displayed the relationship sets
- Each instance in the set relates individual participating entities – one from each participating entity type
- In ER diagrams, we represent the **relationship type** as follows:
  - Diamond-shaped box is used to display a relationship type
  - Connected to the participating entity types via straight lines
  - Note that the relationship type is not shown with an arrow. The name should be typically be readable from left to right and top to bottom.

Refining the Company Database Schema by Introducing Relationships

- By examining the requirements, six relationship types are identified
- All are **binary** relationships(degree 2)
- Listed below with their participating entity types:
  - WORKS_FOR (between EMPLOYEE, DEPARTMENT)
  - MANAGES (also between EMPLOYEE, DEPARTMENT)
  - CONTROLS (between DEPARTMENT, PROJECT)
  - WORKS_ON (between EMPLOYEE, PROJECT)
  - SUPERVISION (between EMPLOYEE (as subordinate), EMPLOYEE (as supervisor))
  - DEPENDENTS_OF (between EMPLOYEE, DEPENDENT)

ER Diagram – Relationship Types Are: WORKS_FOR, MANAGES, WORKS_ON, CONTROLS, SUPERVISION, DEPENDENTS_OF

Figure 3.2 An ER schema diagram for the COMPANY database. The diagrammatic notation is introduced gradually throughout this chapter and is summarized in Figure 3.14 (see slide 51).



Discussion on Relationship Types

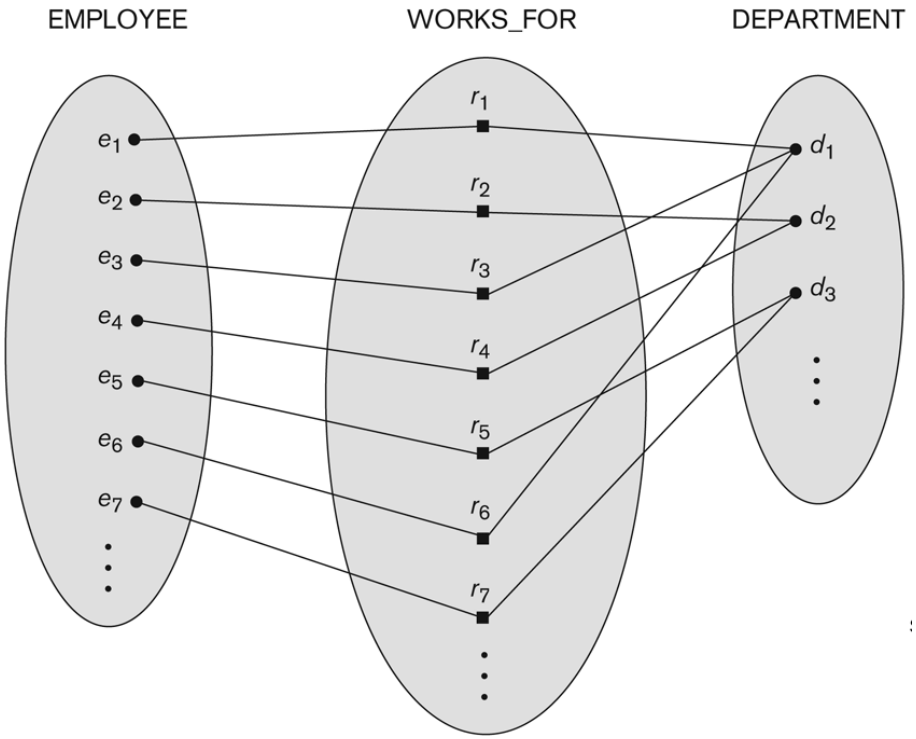
- In the refined design, some attributes from the initial entity types are refined into relationships:
  - Manager of DEPARTMENT → MANAGES
  - Works_on of EMPLOYEE → WORKS_ON
  - Department of EMPLOYEE → WORKS_FOR
  - etc
- In general, more than one relationship type can exist between the same participating entity types
  - MANAGES and WORKS_FOR are distinct relationship types between EMPLOYEE and DEPARTMENT
  - Different meanings and different relationship instances.

Constraints on Relationships

- Constraints on Relationship Types
  - (Also known as ratio constraints)
  - Cardinality Ratio (specifies **maximum** participation)
    - One-to-one (1:1)
    - One-to-many (1:N) or Many-to-one (N:1)
    - Many-to-many (M:N)
  - Existence Dependency Constraint (specifies **minimum** participation) (also called participation constraint)
    - zero (optional participation, not existence-dependent)
    - one or more (mandatory participation, existence-dependent)

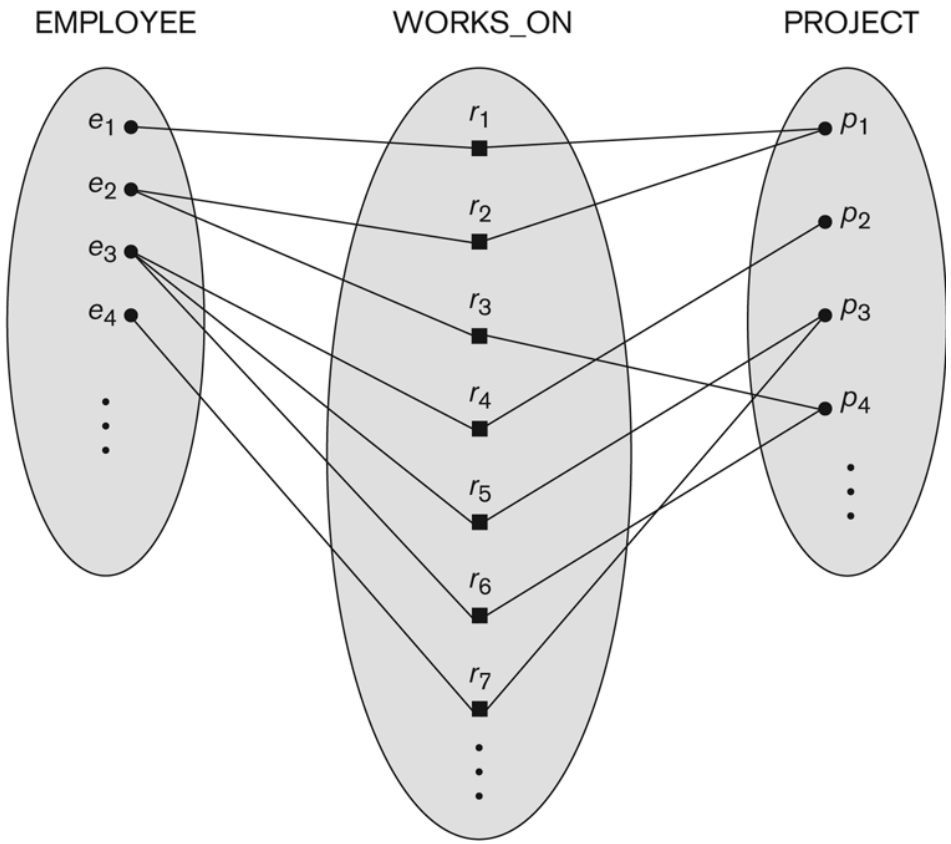
Many-To-One (N:1) Relationship

Figure 3.9 Some instances in the WORKS_FOR relationship set, which represents a relationship type WORKS_FOR between EMPLOYEE and DEPARTMENT.



Many-To-Many (M:N) Relationship

Figure 3.13 An M:N relationship, WORKS_ON.



Recursive Relationship Type

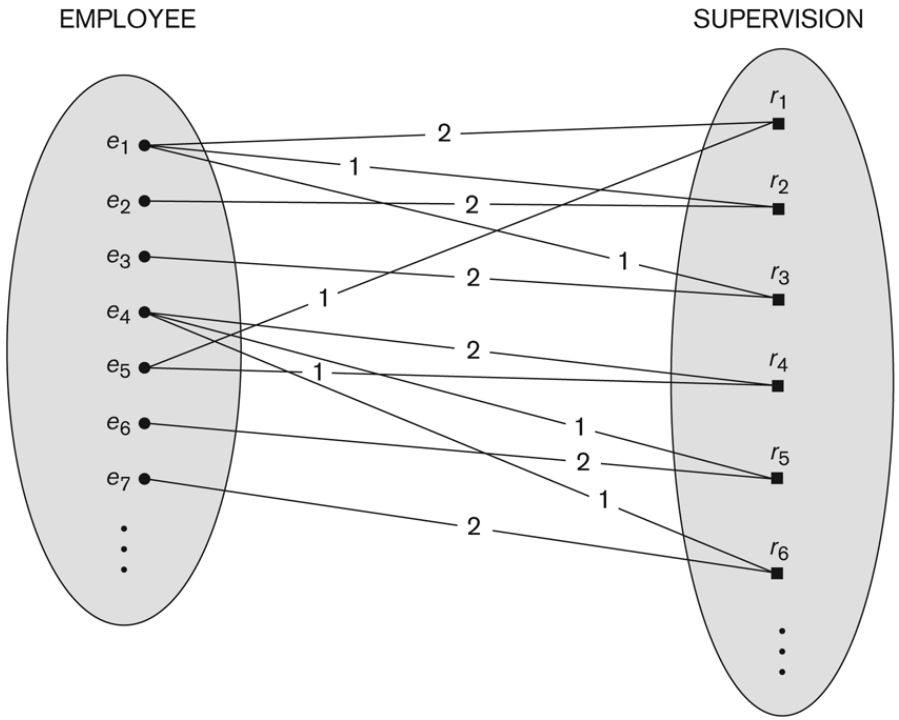
- A relationship type between the same participating entity type in **distinct roles**
- Also called a **self-referencing** relationship type.
- Example: the SUPERVISION relationship
- EMPLOYEE participates twice in two distinct roles:
  - supervisor (or boss) role
  - supervisee (or subordinate) role
- Each relationship instance relates two distinct EMPLOYEE entities:
  - One employee in **supervisor** role
  - One employee in **supervisee** role

Displaying a Recursive Relationship

- In a recursive relationship type.
  - Both participations are same entity type in different roles.
  - For example, SUPERVISION relationships between EMPLOYEE (in role of supervisor or boss) and (another) EMPLOYEE (in role of subordinate or worker).
- In following figure, first role participation labeled with 1 and second role participation labeled with 2.
- In ER diagram, need to display role names to distinguish participations.

A Recursive Relationship Supervision`

Figure 3.11 A recursive relationship SUPERVISION between EMPLOYEE in the **supervisor** role (1) and EMPLOYEE in the **subordinate** role (2).



Recursive Relationship Type is: Supervision (Participation Role Names Are Shown)

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