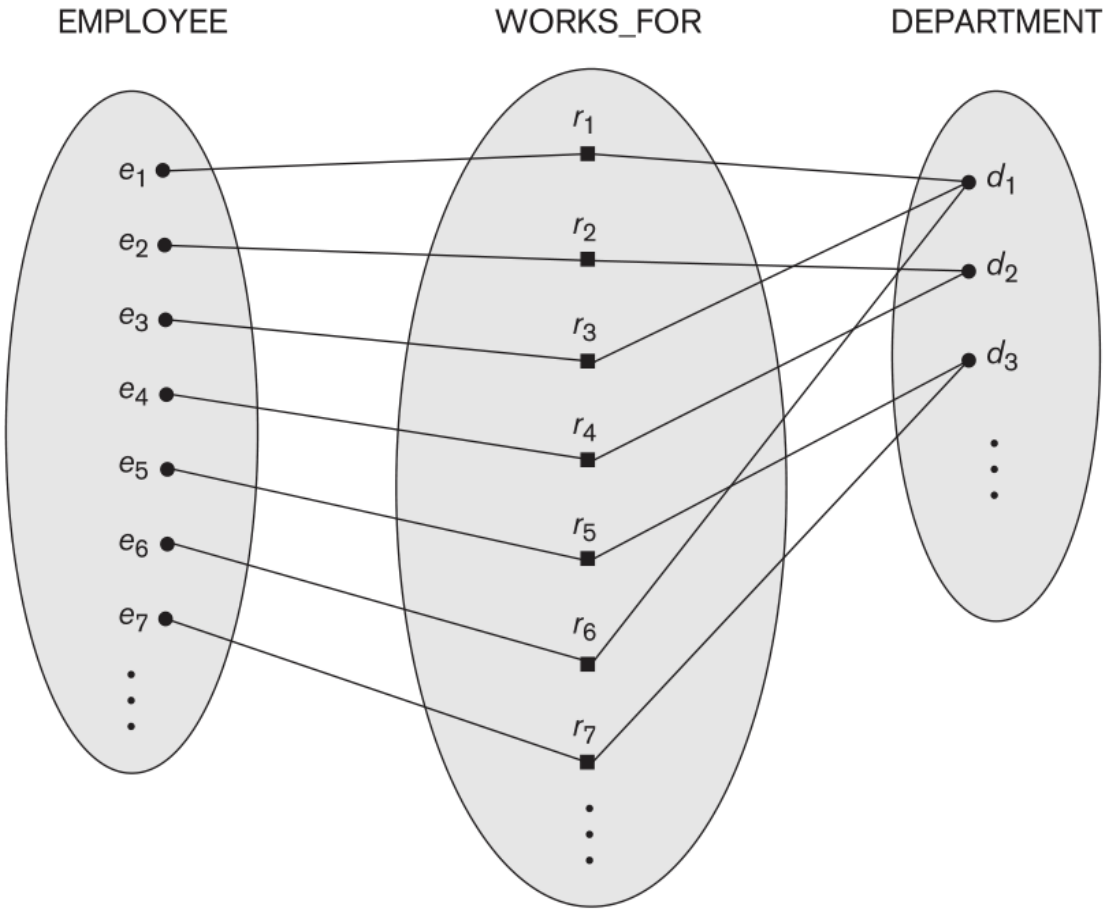
Relationships

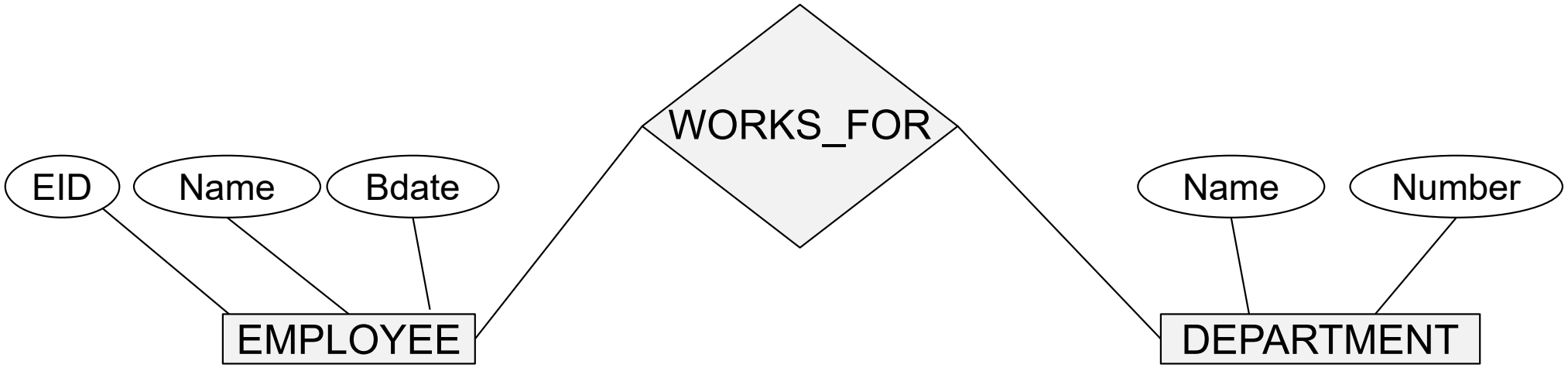
- Relationship: association among two or more entities, e.g., *Employee John works for Department Sales*
- Relationship type: A collection of similar relationships, e.g., *WORKS_FOR is a relationship type between two entity types EMPLOYEE and DEPARTMENT*
- Degree of a relationship type: the number of participating entity types
  - Binary: relationship type of degree two, e.g., *The WORKS_FOR relationship is of degree two*
  - Ternary: relationship type of degree three
  - N-ary: relationship type of degree N

Relationships sets

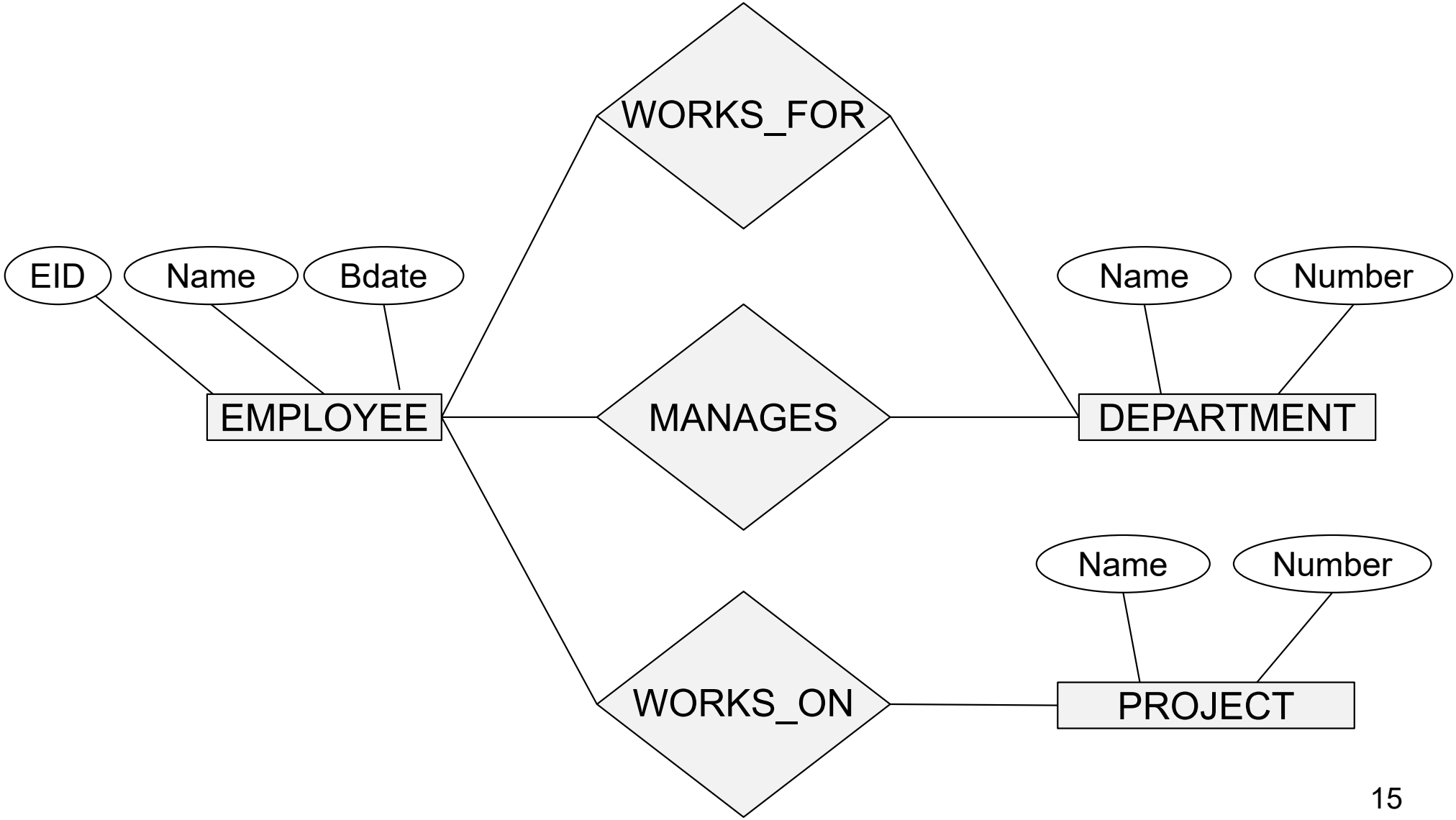


Relationship types in ER diagrams

- Represented as diamond-shaped boxes, connected by straight lines to the rectangular boxes representing the participating entity types
  - The relationship name is displayed in the diamond-shaped box



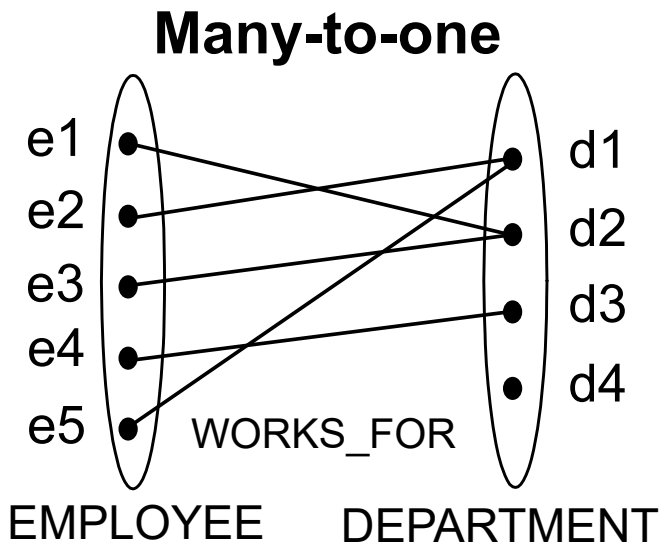
ER diagram example entity and relationship types



Cardinality ratios for binary relationships

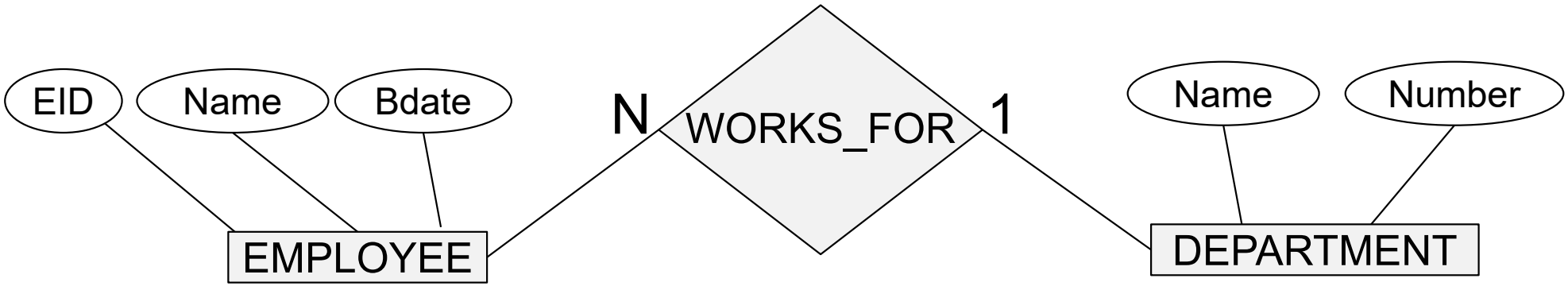
- Cardinality ratio for a binary relationship specifies the *maximum* number of relationship instances that an entity can participate in
- Possible cardinality ratios for binary relationship types: 1:1, 1:N, N:1, and M:N, e.g., in the binary relationship type R between entity types E1 and E2, E1:E2 can be of cardinality ratio:
  - 1:1, i.e., *each entity of E1 can be related to at most one entity of E2 (1), and an entity of E2 can be related to at most one entity of E1 (1)*
  - 1:N, i.e., *each entity of E1 can be related to any number of entities of E2 (N), but an entity of E2 can be related to at most one entity of E1 (1)*
  - N:1, i.e., *each entity of E1 can be related to at most one entity of E2 (1) but an entity of E2 can be related to any number of entities of E1 (N)*
  - M:N, i.e., *each entity of E1 can be related to any number of entities of E2 (N) and an entity of E2 can be related to any number of entities of E1 (M)*

Cardinality ratio N:1

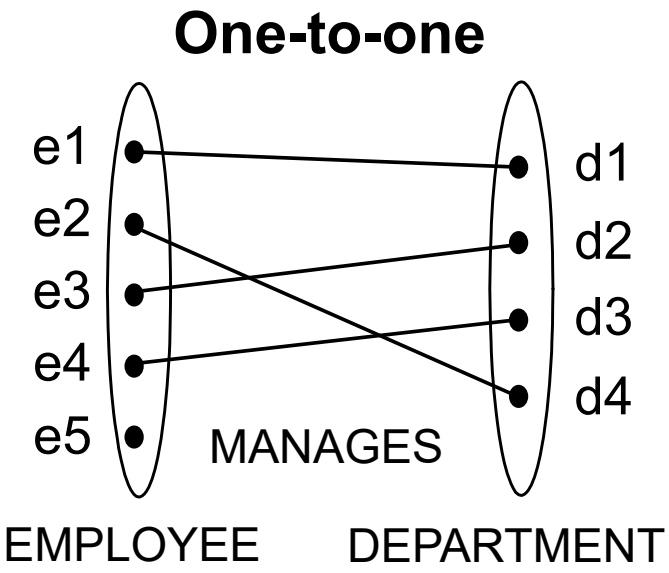


Each EMPLOYEE participates in **at most one** WORKS_FOR relationship, i.e., given an employee, the department is unique (not more than one employment!)

Represented on ER diagrams by displaying N and 1 on the relationship diamond

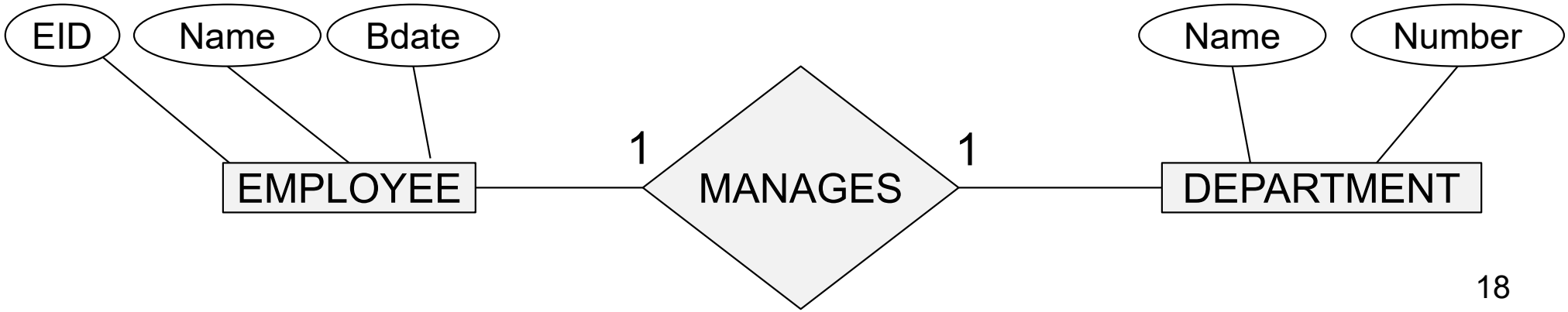


Cardinality ratio 1:1

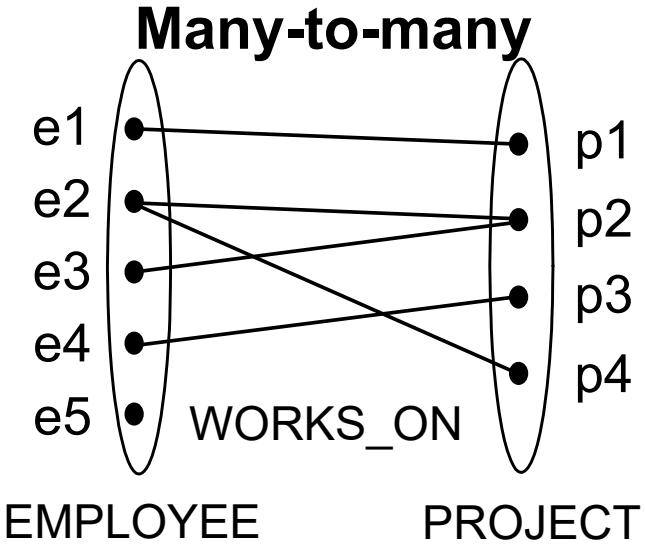


Each DEPARTMENT has **at most one** manager and each EMPLOYEE can manage **at most one** DEPARTMENT

Represented on ER diagrams by displaying 1 and 1 on the relationship diamond

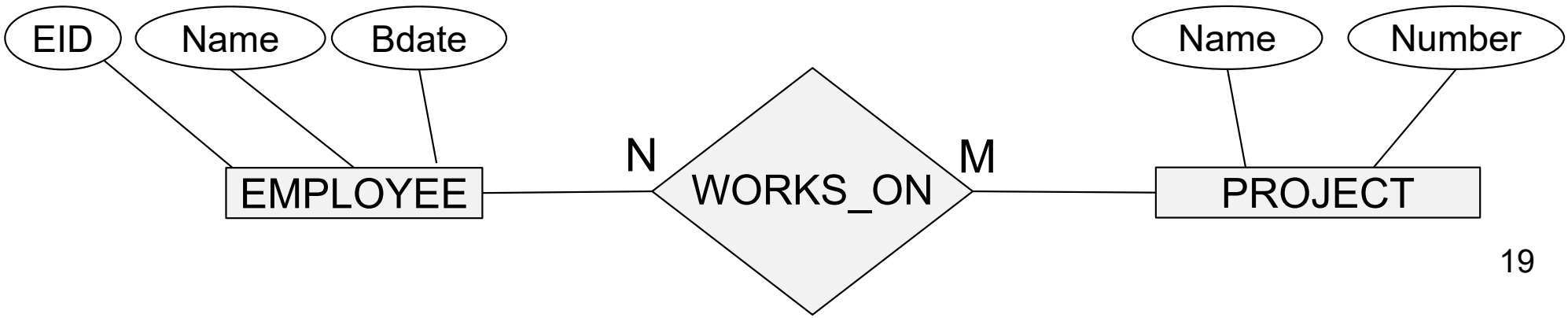


Cardinality ratio N:M



Each EMPLOYEE can work on many projects and in each PROJECT many employees can work

Represented on ER diagrams by displaying N and M on the relationship diamond

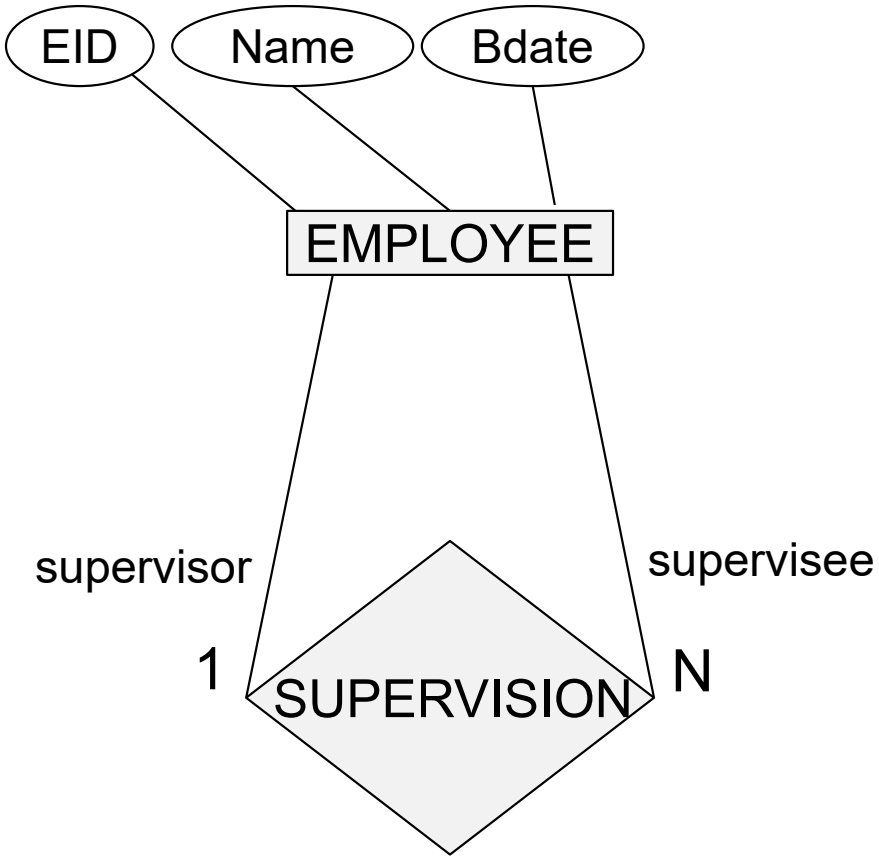


Roles in relationships

- Each entity type that participates in a relationship type plays a particular role in the relationship
  - The role name signifies the role that a participating entity from the entity type plays in each relationship instance, e.g.,
    In the WORKS_FOR relationship type, EMPLOYEE plays the role of employee or worker and DEPARTMENT plays the role of department or employer
- Mostly used in recursive relationships
  - The *same* entity type participates more than once in a relationship type, e.g.,
    The SUPERVISION relationship type relates an employee (in the role of supervisee) to another employee (in the role of supervisor)

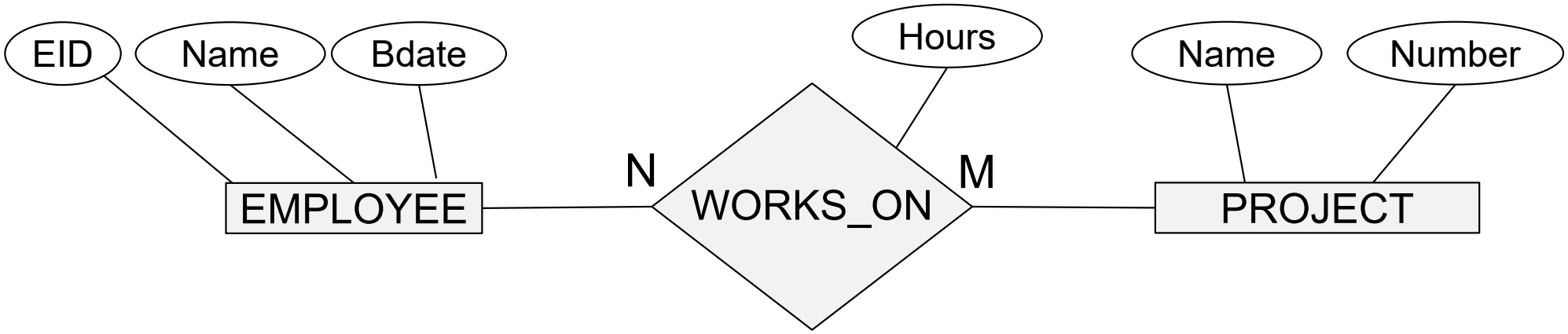
Roles in ER diagrams

- Represented on ER diagrams by displaying the role names on the edges of the relationship



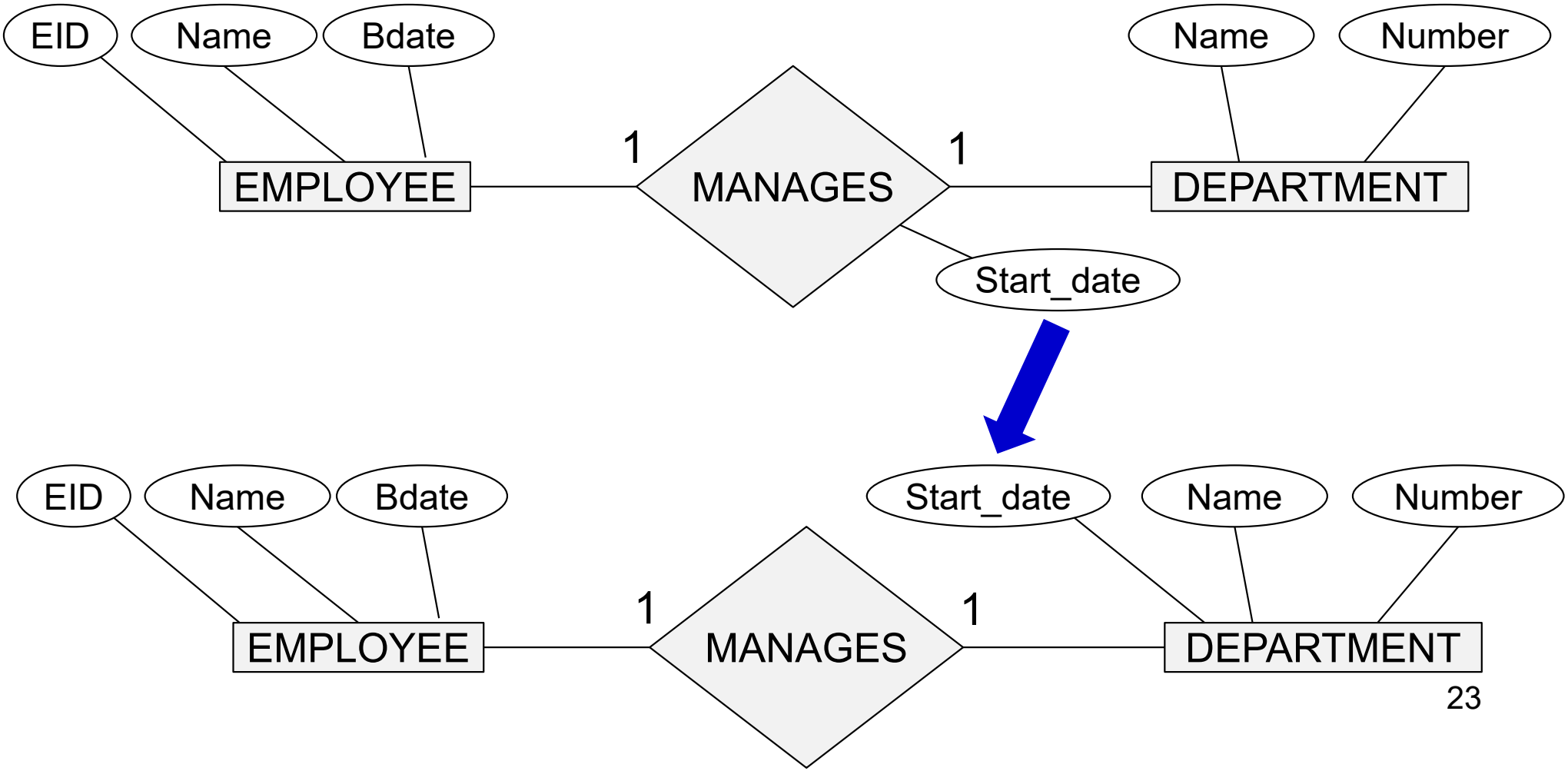
Attributes of relationship types

- Relationship types can have attributes, e.g.,
  To record the number of hours per week that a particular employee works on a particular project, we can include attribute Hours for the WORKS_ON relationship type
- A relationship attribute is depicted similarly to entity attributes, but the line is connected to the relation box



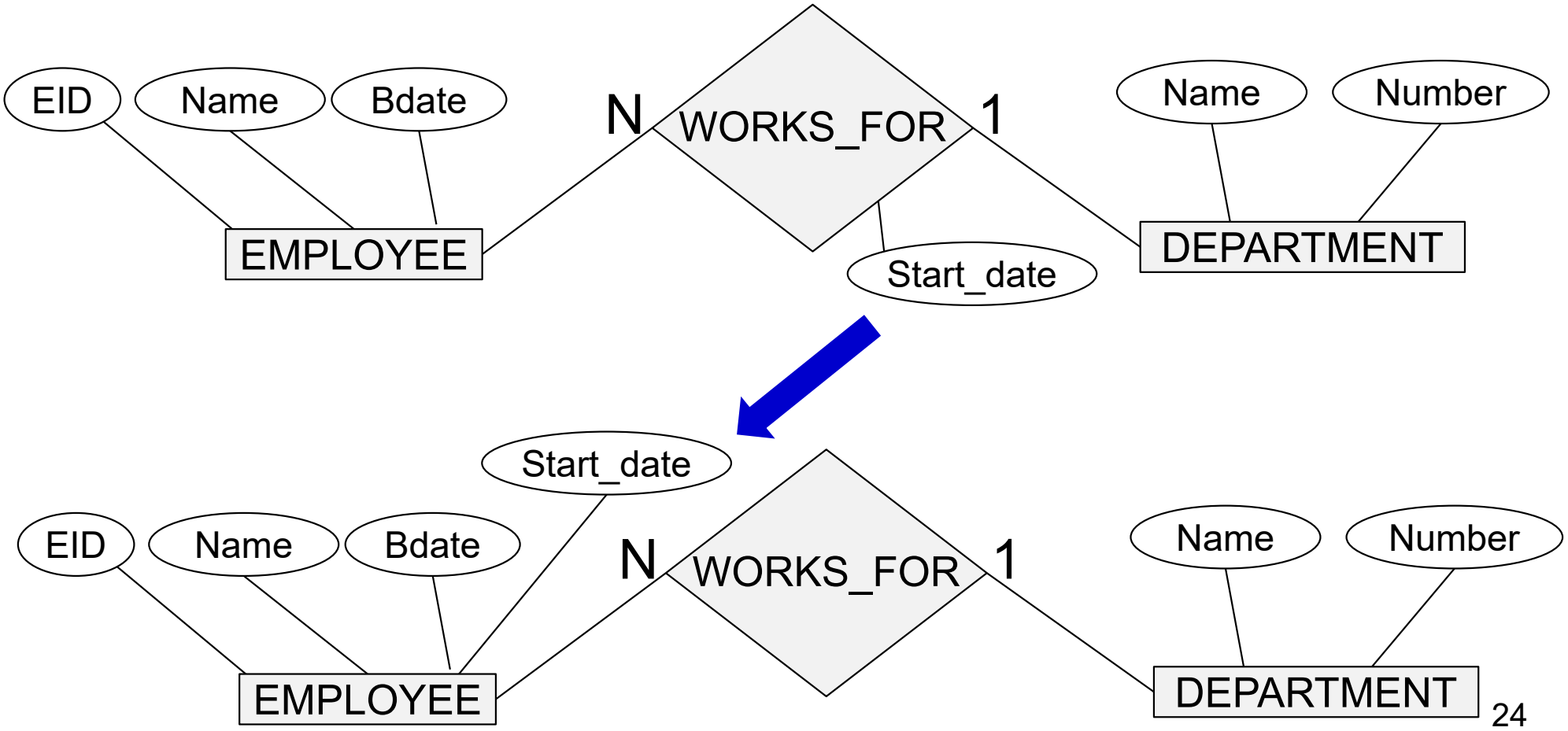
Attributes of relationship types (cont')

- Attributes of 1:1 or 1:N relationship types can be migrated to one of the participating entity types, e.g.,



Attributes of relationship types (cont')

- Attributes of N:1 relationship types can be migrated *only* to the entity type on the N-side of the relationship



Attributes of relationship types (cont')

- For M:N (many-to-many), the attributes determined by the combination of participating entities in a relationship instance must be specified as relationship attributes

