



CHAPTER 9

Relational Database Design by ER- and EERR-to-Relational Mapping

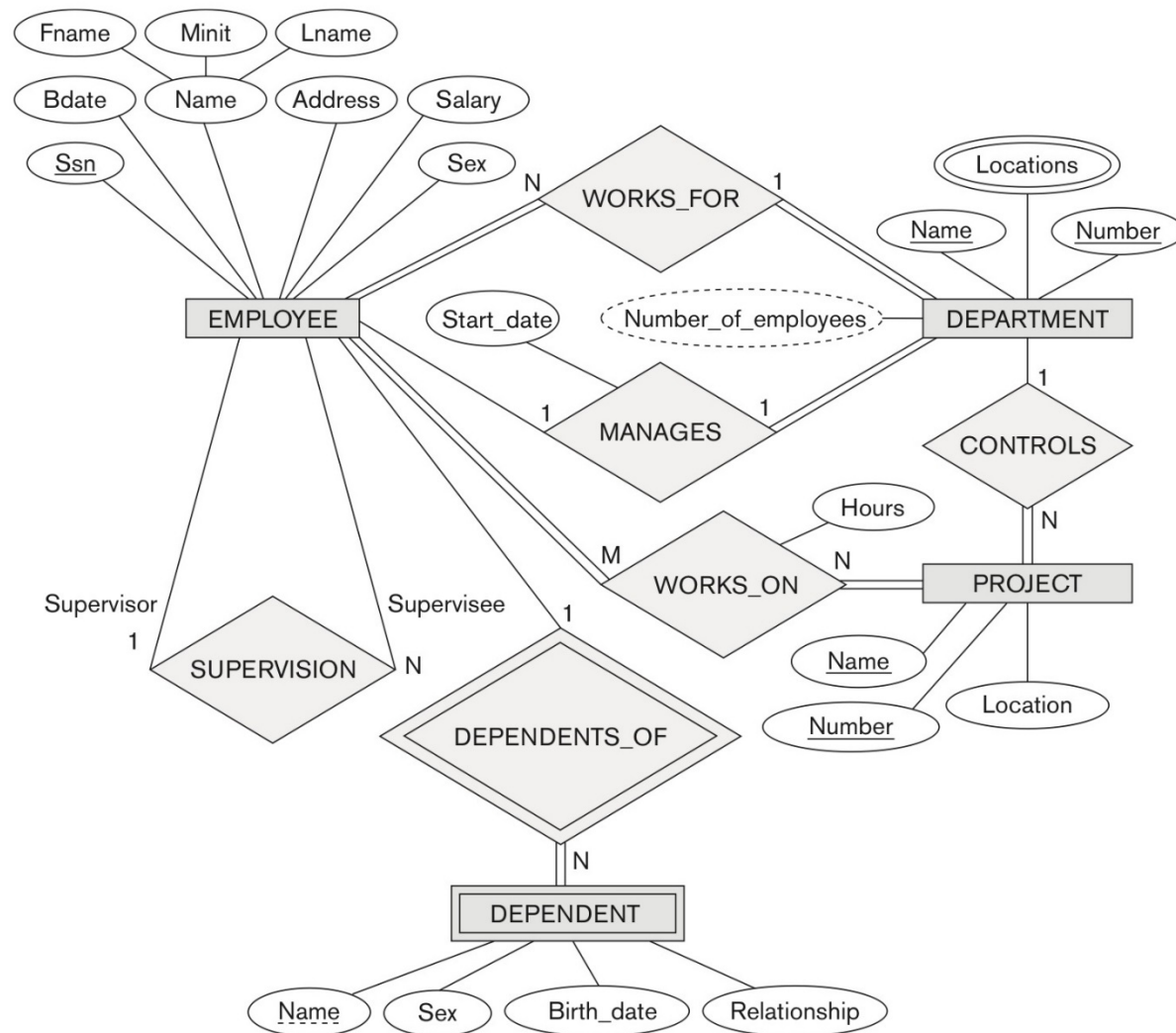
Chapter Outline

- **ER-to-Relational Mapping Algorithm**
 - Step 1: Mapping of Regular Entity Types
 - Step 2: Mapping of Weak Entity Types
 - Step 3: Mapping of Binary 1:1 Relation Types
 - Step 4: Mapping of Binary 1:N Relationship Types.
 - Step 5: Mapping of Binary M:N Relationship Types.
 - Step 6: Mapping of Multivalued attributes.
 - Step 7: Mapping of N-ary Relationship Types.

ER-to-Relational Mapping Algorithm

- Step 1: Mapping of Regular Entity Types.
 - For each regular (strong) entity type E in the ER schema, create a relation R that includes all the simple attributes of E.
 - Choose one of the key attributes of E as the primary key for R.
 - If the chosen key of E is composite, the set of simple attributes that form it will together form the primary key of R.
- Example: We create the relations EMPLOYEE, DEPARTMENT, and PROJECT in the relational schema corresponding to the regular entities in the ER diagram.
 - SSN, DNUMBER, and PNUMBER are the primary keys for the relations EMPLOYEE, DEPARTMENT, and PROJECT as shown.

Figure 9.1 The ER diagram for the COMPANY database.



ER-to-Relational Mapping Algorithm (contd.)

■ Step 2: Mapping of Weak Entity Types

- For each weak entity type W in the ER schema with owner entity type E , create a relation R & include all simple attributes (or simple components of composite attributes) of W as attributes of R .
- Also, include as foreign key attributes of R the primary key attribute(s) of the relation(s) that correspond to the owner entity type(s).
- The primary key of R is the *combination* of the primary key(s) of the owner(s) and the partial key of the weak entity type W , if any.

■ Example: Create the relation DEPENDENT in this step to correspond to the weak entity type DEPENDENT.

- Include the primary key SSN of the EMPLOYEE relation as a foreign key attribute of DEPENDENT (renamed to ESSN).
- The primary key of the DEPENDENT relation is the combination {ESSN, DEPENDENT_NAME} because DEPENDENT_NAME is the partial key of DEPENDENT.

ER-to-Relational Mapping Algorithm (contd.)

■ Step 3: Mapping of Binary 1:1 Relation Types

- For each binary 1:1 relationship type R in the ER schema, identify the relations S and T that correspond to the entity types participating in R.
- There are three possible approaches:
 1. **Foreign Key (2 relations) approach:** Choose one of the relations-say S-and include a foreign key in S the primary key of T. It is better to choose an entity type with total participation in R in the role of S.
 - Example: 1:1 relation MANAGES is mapped by choosing the participating entity type DEPARTMENT to serve in the role of S, because its participation in the MANAGES relationship type is total.
 2. **Merged relation (1 relation) option:** An alternate mapping of a 1:1 relationship type is possible by merging the two entity types and the relationship into a single relation. This may be appropriate when both participations are total.
 3. **Cross-reference or relationship relation (3 relations) option:** The third alternative is to set up a third relation R for the purpose of cross-referencing the primary keys of the two relations S and T representing the entity types.

ER-to-Relational Mapping Algorithm (contd.)

- Step 4: Mapping of Binary 1:N Relationship Types.
 - For each regular binary 1:N relationship type R, identify the relation S that represent the participating entity type at the N-side of the relationship type.
 - Include as foreign key in S the primary key of the relation T that represents the other entity type participating in R.
 - Include any simple attributes of the 1:N relation type as attributes of S.
- Example: 1:N relationship types WORKS_FOR, CONTROLS, and SUPERVISION in the figure.
 - For WORKS_FOR we include the primary key DNUMBER of the DEPARTMENT relation as foreign key in the EMPLOYEE relation and call it DNO.
- An alternative approach is to use a Relationship relation (cross referencing relation) – this is rarely done.

ER-to-Relational Mapping Algorithm (contd.)

- **Step 5: Mapping of Binary M:N Relationship Types.**
 - For each regular binary M:N relationship type R, *create a new relation S to represent R. This is a relationship relation.*
 - Include as foreign key attributes in S the primary keys of the relations that represent the participating entity types; *their combination will form the primary key of S.*
 - Also include any simple attributes of the M:N relationship type (or simple components of composite attributes) as attributes of S.
- **Example: The M:N relationship type WORKS_ON from the ER diagram is mapped by creating a relation WORKS_ON in the relational database schema.**
 - The primary keys of the PROJECT and EMPLOYEE relations are included as foreign keys in WORKS_ON and renamed PNO and ESSN, respectively.
 - Attribute HOURS in WORKS_ON represents the HOURS attribute of the relation type. The primary key of the WORKS_ON relation is the combination of the foreign key attributes {ESSN, PNO}.

ER-to-Relational Mapping Algorithm (contd.)

- **Step 6: Mapping of Multivalued attributes.**
 - For each multivalued attribute A, create a new relation R.
 - This relation R will include an attribute corresponding to A, plus the primary key attribute K-as a foreign key in R-of the relation that represents the entity type of relationship type that has A as an attribute.
 - The primary key of R is the combination of A and K. If the multivalued attribute is composite, we include its simple components.
- **Example: The relation DEPT_LOCATIONS is created.**
 - The attribute DLOCATION represents the multivalued attribute LOCATIONS of DEPARTMENT, while DNUMBER-as foreign key-represents the primary key of the DEPARTMENT relation.
 - The primary key of R is the combination of {DNUMBER, DLOCATION}.

ER-to-Relational Mapping Algorithm (contd.)

- **Step 7: Mapping of N-ary Relationship Types.**
 - For each n-ary relationship type R, where $n > 2$, create a new relationship S to represent R.
 - Include as foreign key attributes in S the primary keys of the relations that represent the participating entity types.
 - Also include any simple attributes of the n-ary relationship type (or simple components of composite attributes) as attributes of S.
- **Example:** The relationship type SUPPY in the ER on the next slide.
 - This can be mapped to the relation SUPPLY shown in the relational schema, whose primary key is the combination of the three foreign keys {SNAME, PARTNO, PROJNAME}

Figure 9.2 Result of mapping the COMPANY ER schema into a relational database schema.

EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
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DEPARTMENT

Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date
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DEPT_LOCATIONS

<u>Dnumber</u>	<u>Dlocation</u>
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PROJECT

Pname	<u>Pnumber</u>	<u>Plocation</u>	Dnum
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WORKS_ON

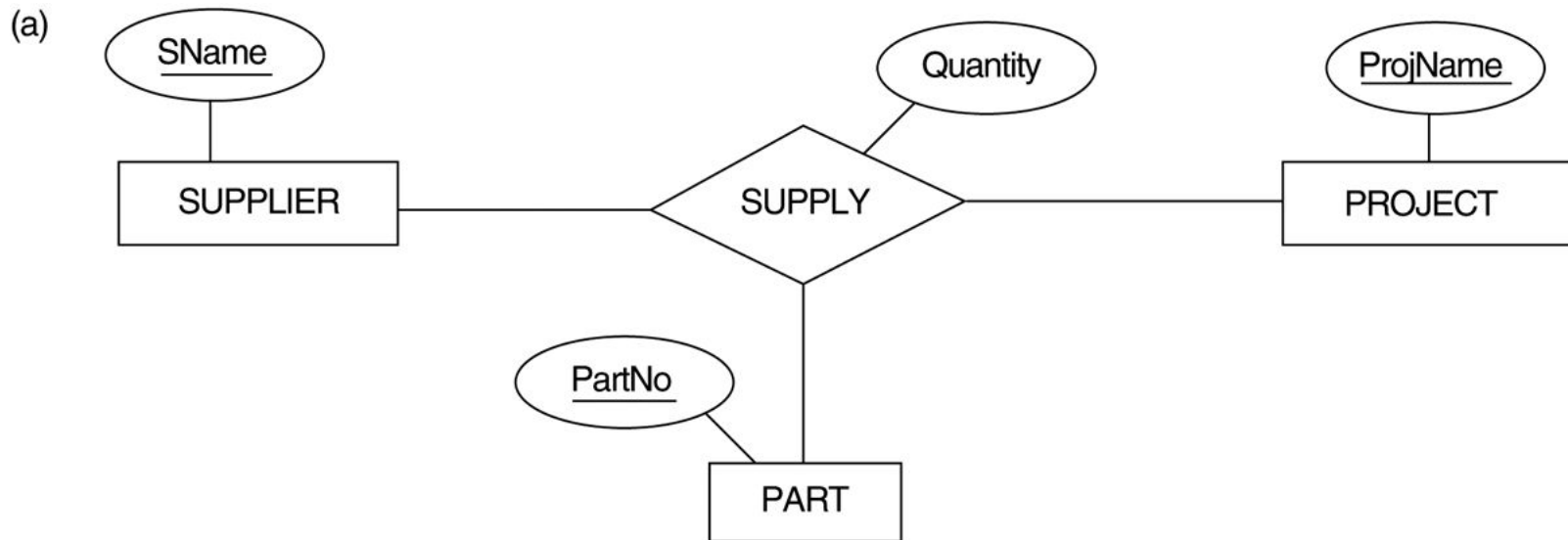
<u>Essn</u>	<u>Pno</u>	Hours
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DEPENDENT

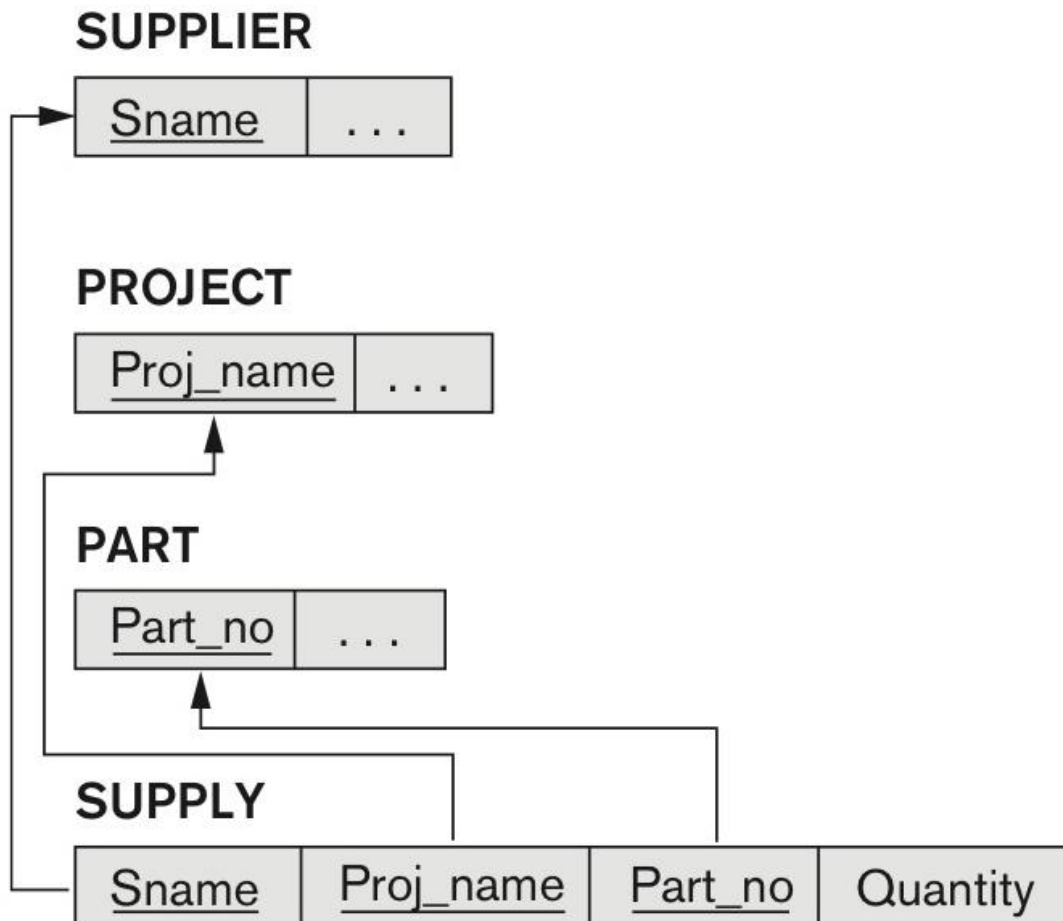
<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
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FIGURE 3.17

TERNARY RELATIONSHIP: SUPPLY



Mapping the *n*-ary relationship type SUPPLY



Quiz

Perform ERD to Relational Mapping

