

ER to Relational Mapping

Mirunalini.P

SSNCE

April 7, 2022

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Session Objective

- To learn ER-to-Relational Mapping

At the end of this session, participants will be able to

- To Map relation from ER diagram

ER-to-Relational Mapping Algorithm

- Mapping of Regular Entity Types
- Mapping of Multivalued attributes.
- Mapping of Weak Entity Types
- Mapping of Binary 1:1 Relation Types
- Mapping of Binary 1:N Relationship Types.
- Mapping of Binary M:N Relationship Types.
- Mapping of N-ary Relationship Types.

Relational Database Design by ER-Relational Mapping

- **Relations:** (tables) Correspond with entity types and with many to many relationship type
- **Rows:** Correspond with entity instances and with many to many relationship instances
- **Columns** Correspond with attributes

ER-to-Relational Mapping Algorithm

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.

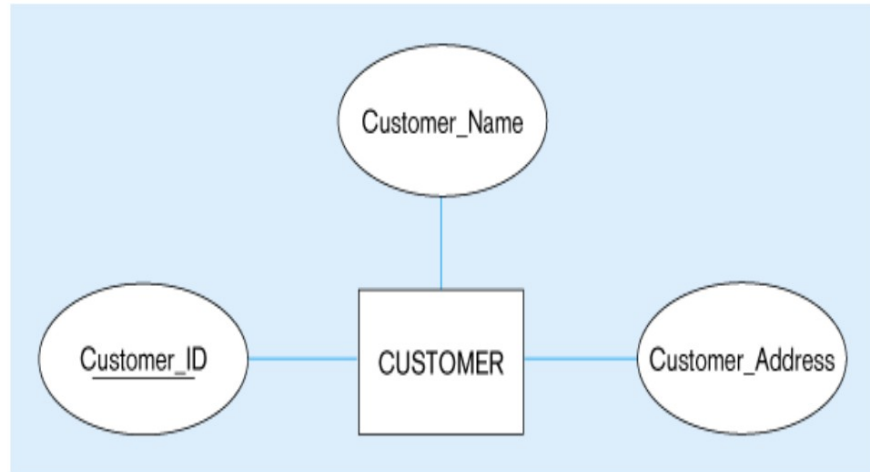
Mapping Regular Entities to Relations

- **Simple attributes:** ER attributes map directly onto the relation
- **Composite attributes:** Use only their simple, component as attributes
- **Multivalued Attribute:** Becomes a separate relation with a foreign key taken from the superior entity

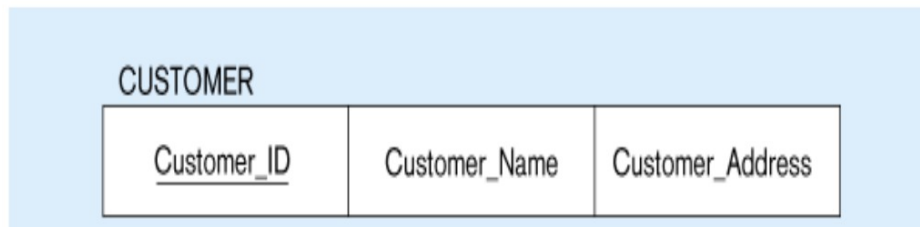
Mapping Regular Entity Types - Simple Attributes

Mapping regular entity types

(a) CUSTOMER entity type with simple attributes



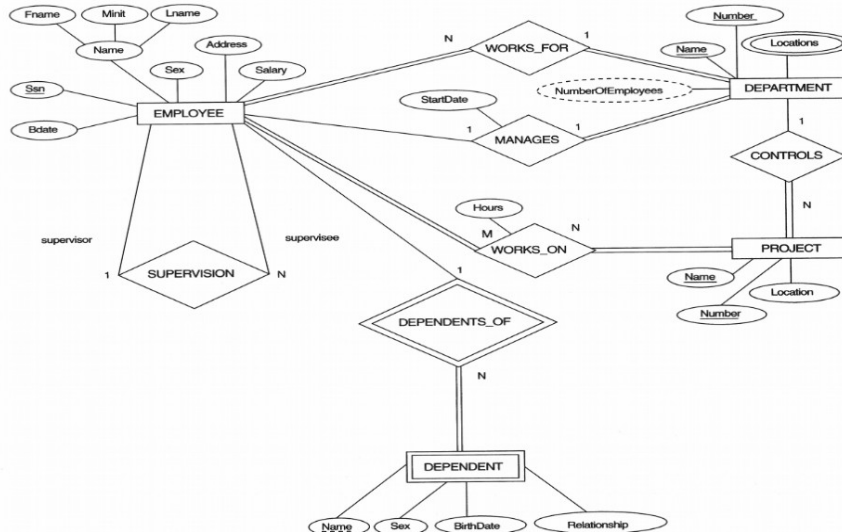
(b) CUSTOMER relation



Simple Attributes

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



ER to Relation

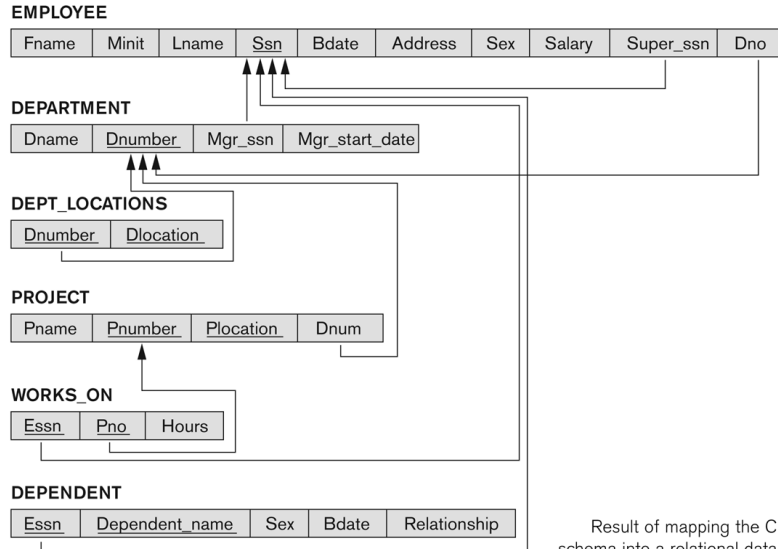
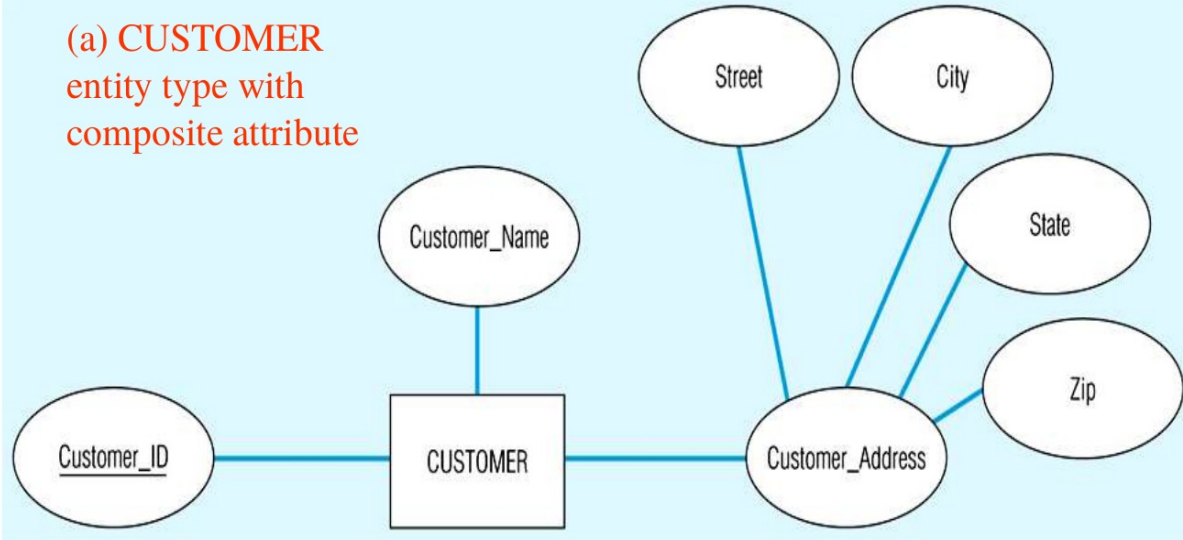


Figure 7.2
Result of mapping the COMPANY ER
schema into a relational database schema.

Mapping Regular Entity Types - Composite Attributes

Mapping regular entity types

(a) CUSTOMER
entity type with
composite attribute



(b) CUSTOMER relation with address detail

CUSTOMER

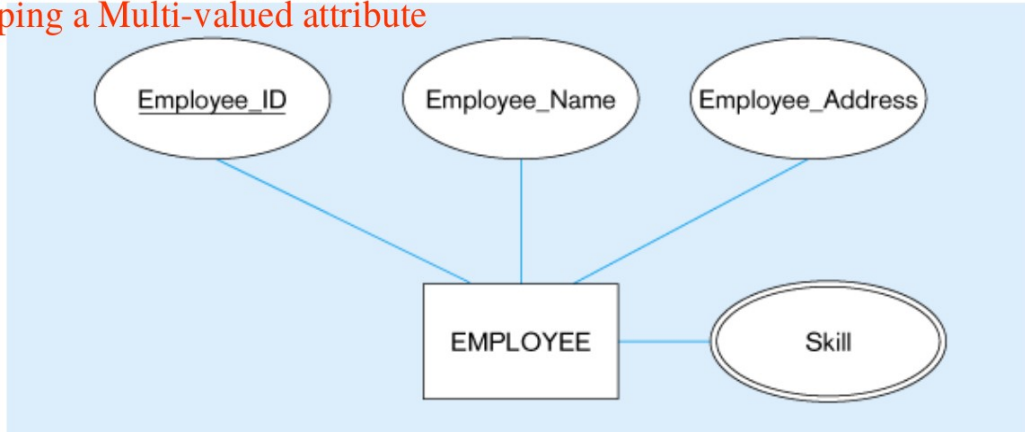
<u>Customer_ID</u>	Customer_Name	Street	City	State	Zip
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2. Mapping Regular Entity Types - Multivalued Attributes

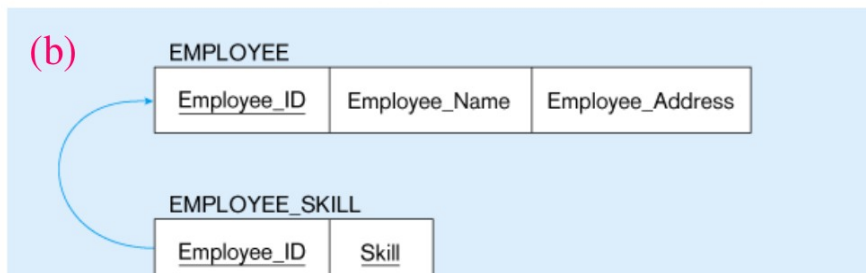
- For each multivalued attribute A, create a new relation R.
- This relation R will include an attribute corresponding to A, plus the primary key attribute K-as a foreign key in R-of the relation that represents the entity type of relationship type that has A as an attribute.
- The primary key of R is the combination of A and K. If the multivalued attribute is composite, we include its simple components.

2. Mapping Regular Entity Types - Multivalued Attributes

Mapping a Multi-valued attribute



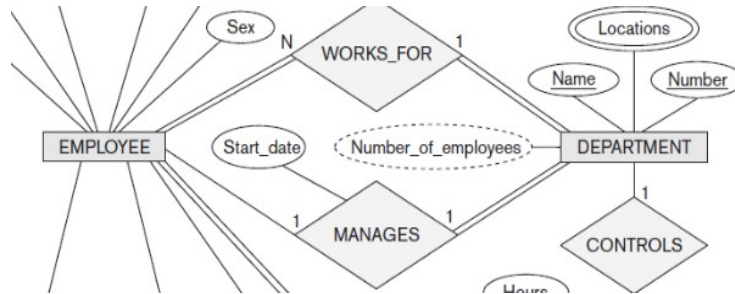
Multivalued attribute becomes a separate relation with foreign key



2. Mapping Regular Entity Types - Multivalued Attributes

- 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.

Mapping Regular Entity Types - Multivalued Attributes



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

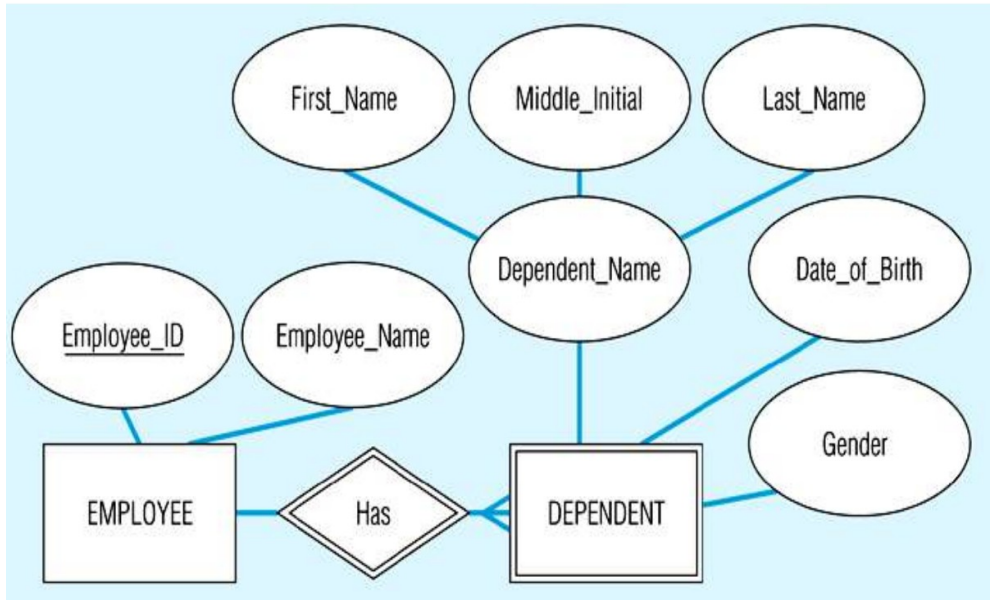
<u>Dnumber</u>	<u>Dlocation</u>
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3: Mapping of Weak Entity Types

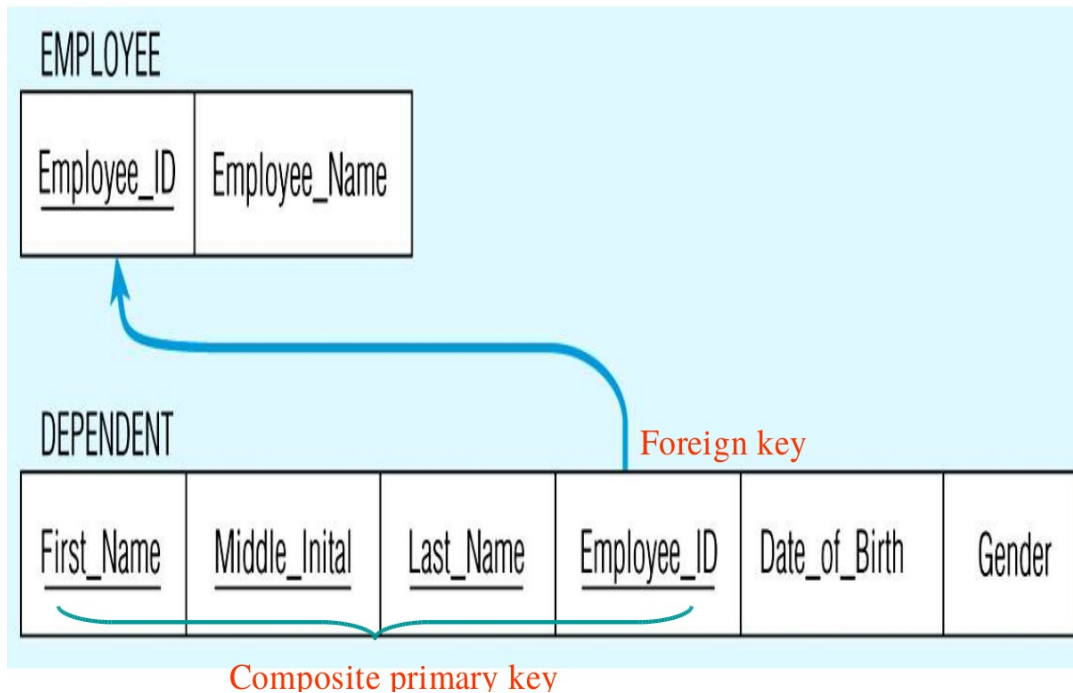
- For each weak entity type W in the ER schema with owner entity type E , create a relation R & include all simple attributes (or simple components of composite attributes) of W as attributes of R .
- Include as foreign key attributes of R the primary key attribute(s) of the relation(s) that correspond 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.

Mapping of Weak Entity Types

Mapping weak entity types



Mapping of Weak Entity Types



Mapping of Weak Entity Types

- 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`.

Mapping of Weak Entity Types

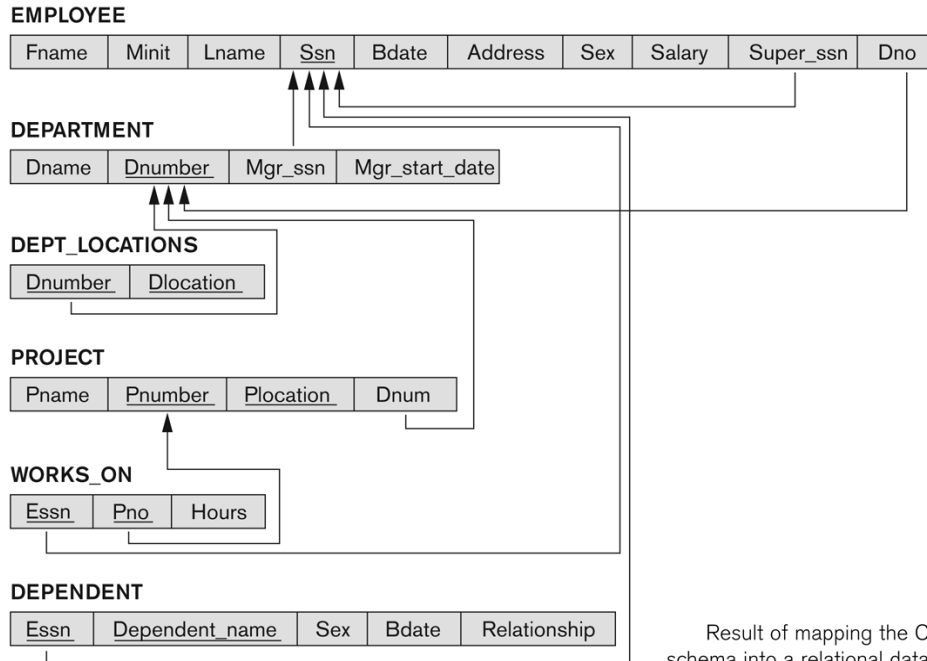
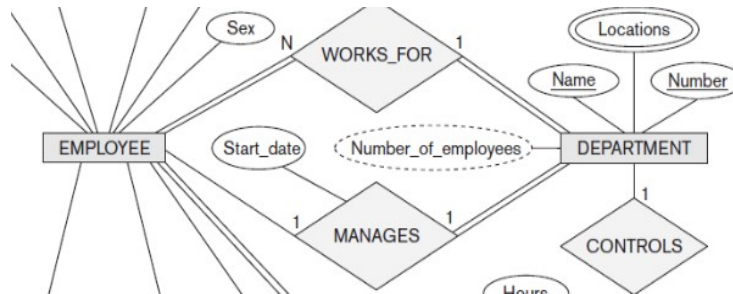


Figure 7.2
Result of mapping the COMPANY ER
schema into a relational database schema.

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 .
 - **Foreign Key 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 ,
 - **Merged 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.
 - **Cross-reference or relationship relation 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. This approach suitable for binary M:N relationships.

Foreign Key approach



EMPLOYEE

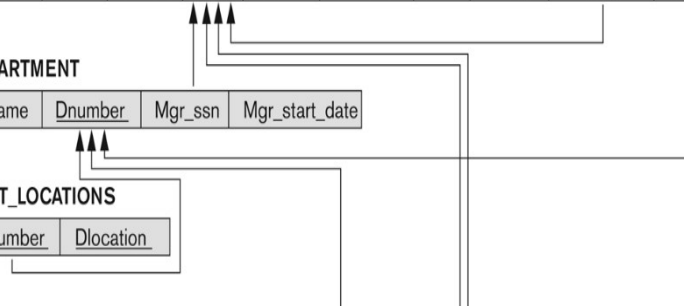
Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
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DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
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DEPT_LOCATIONS

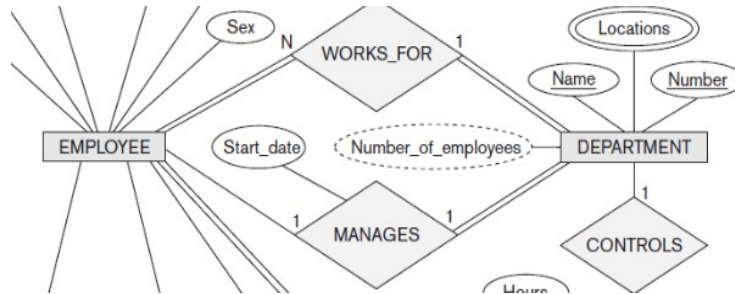
Dnumber	Dlocation
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5. Mapping of Binary 1:N Relationship Types

- 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(N side) the primary key of the relation (1 side) 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.

Mapping of Binary 1:N Relationship Types



EMPLOYEE

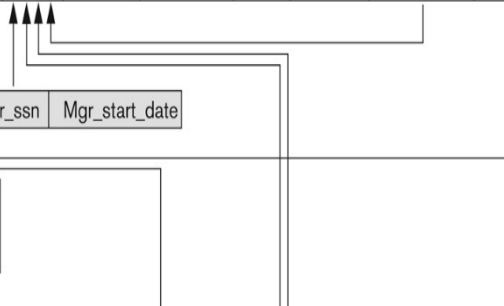
Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
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DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
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DEPT_LOCATIONS

Dnumber	Dlocation
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Mapping of Binary M:N Relationship Types

- For each regular binary M:N relationship type R, create a new relation S to represent R.
- 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.

Step 6: Mapping of Binary M:N Relationship Types

-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.

Mapping of Binary M:N Relationship Types

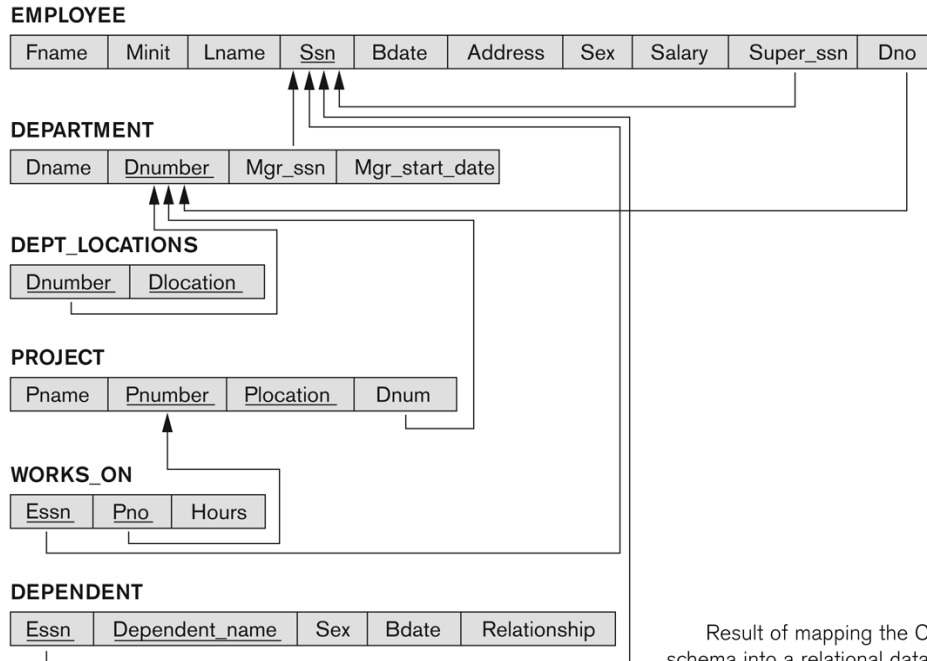
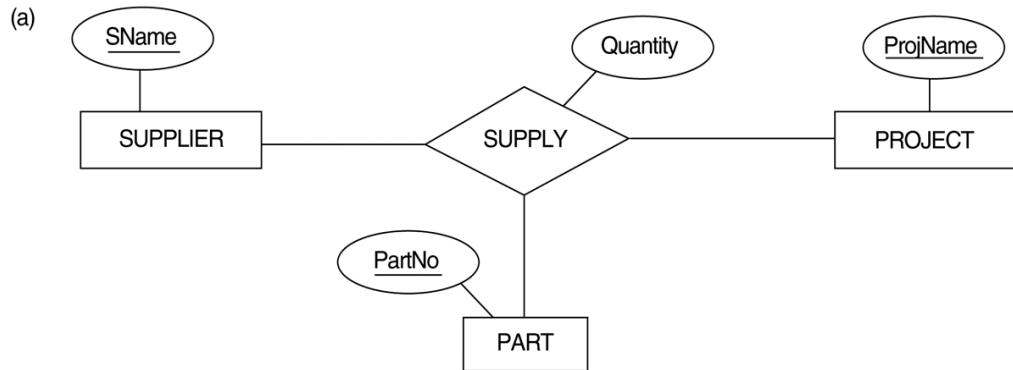


Figure 7.2
Result of mapping the COMPANY ER
schema into a relational database schema.

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 SUPPLY in the ER.
- 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

Mapping of N-ary Relationship Types



Mapping of N-ary Relationship Types

SUPPLIER

<u>SNAME</u>	...
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PROJECT

<u>PROJNAME</u>	...
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PART

<u>PARTNO</u>	...
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SUPPLY

<u>SNAME</u>	PROJNAME	<u>PARTNO</u>	QUANTITY
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Summary of Relationship Types

Correspondence between ER and Relational Models

ER Model

Entity type
1:1 or 1:N relationship type
M:N relationship type
 n -ary relationship type
Simple attribute
Composite attribute
Multivalued attribute
Value set
Key attribute

Relational Model

“Entity” relation
Foreign key (or “relationship” relation)
“Relationship” relation and two foreign keys
“Relationship” relation and n foreign keys
Attribute
Set of simple component attributes
Relation and foreign key
Domain
Primary (or secondary) key



Fundamentals of Database systems 7th Edition by Ramez Elmasri.