

RELATIONAL DATABASE DESIGN VIA ER MODELLING

CHAPTER 9 (6/E)

CHAPTER 7 (5/E)

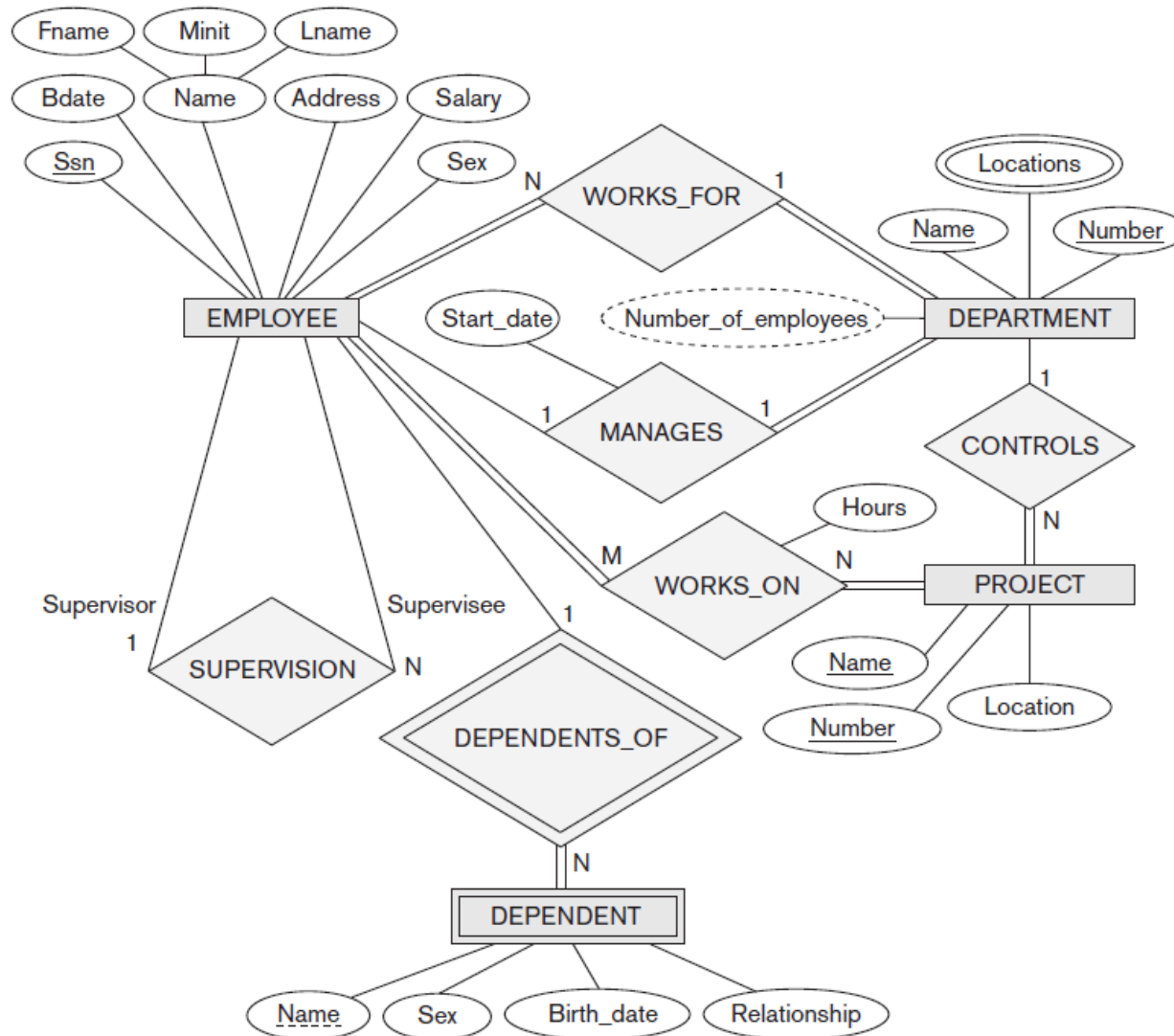
CHAPTER 9 OUTLINE

- Relational Database Design Using ER-to-Relational Mapping
 - Algorithm to convert the basic ER model constructs into relations
- Mapping EER Model Constructs to Relations
 - Additional steps for EER model

RECALL (BASIC) ER DIAGRAM

Figure 9.1

The ER conceptual schema diagram for the COMPANY database.



END GOAL: RELATIONAL MODEL

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 9.2

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

STEP 1: MAP REGULAR ENTITY TYPES

- For each regular entity type, create a relation schema R that includes all the single-valued attributes of E
 - “Flatten” composite attributes
 - Example renames some attributes (e.g., Dname), but not needed
 - Pick one of the keys as “primary key” and declare the rest to be unique
 - Called **entity relations**
 - Each tuple represents an entity instance

(a) EMPLOYEE

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

Dname	<u>Dnumber</u>
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PROJECT

Pname	<u>Pnumber</u>	Plocation
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STEP 2: MAP WEAK ENTITY TYPES

- For each weak entity type, create a relation schema R and include all single-valued attributes of the entity type as attributes of R
 - Include primary key attribute of “owner” as foreign key attribute of R
 - Primary key of R is primary key of owner together with discriminant attribute from R

(b) DEPENDENT

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
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STEP 3: MAP BINARY 1:1

RELATIONSHIP TYPES

- For each binary 1:1 relationship type R , identify relation schemas that correspond to entity types participating in R
 - Apply one of three possible approaches:
 - **Foreign key approach**
 - Add primary key of one participating relation as foreign key attribute of the other, which will also represent R
 - If only one side is *total*, choose it to represent R (*why?*)
 - Declare foreign key attribute as unique
 - **Merged relationship approach**
 - Combine the two relation schemas into one, which will also represent R
 - Make one of the primary keys “unique” instead
 - **Cross-reference or relationship relation approach**
 - Create new relation schema for R with two foreign key attributes being copies of both primary keys
 - Declare one of the attributes as primary key and the other one as unique
 - Add single-valued attributes of relationship type as attributes of R

STEP 4: MAP BINARY 1:N

RELATIONSHIP TYPES

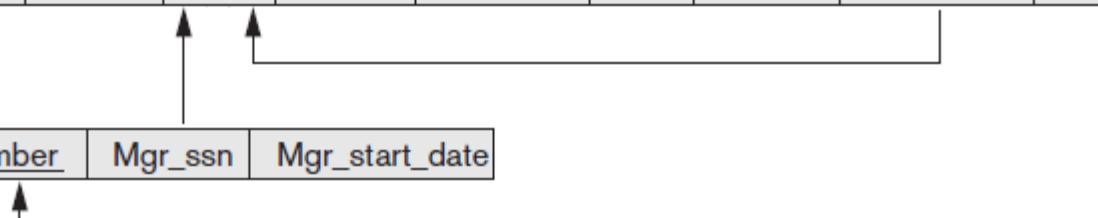
- **Foreign key approach**
 - Identify relation schema S that represents participating entity type at N -side of 1: N relationship type
 - Include primary key of other entity type (1-side) as foreign key in S
- **Relationship relation approach**
 - Create new relation schema for S with two foreign key attributes being copies of both primary keys
 - Declare the *pair* of attributes as primary key
- Include single-valued attributes of relationship type as attributes of S

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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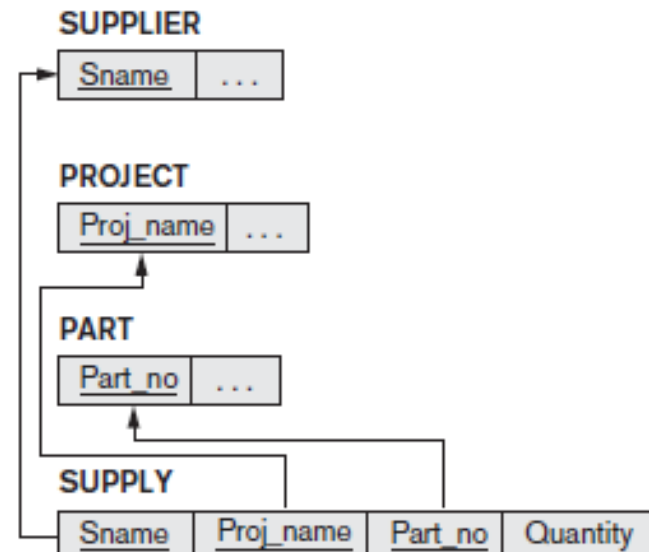


STEP 5: MAP BINARY *M:N* AND HIGHER ORDER RELATIONSHIP TYPES

- For each binary *M:N* relationship type or ternary or higher order relationship type, create a new relation *S*
 - Include primary key of participating entity types as foreign key attributes in *S*
 - Make all these attributes primary key of *S*
 - Include any simple attributes of relationship type in *S*

(c) WORKS_ON

<u>Essn</u>	<u>Pno</u>	Hours
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STEP 6: MAP MULTIVALUED ATTRIBUTES

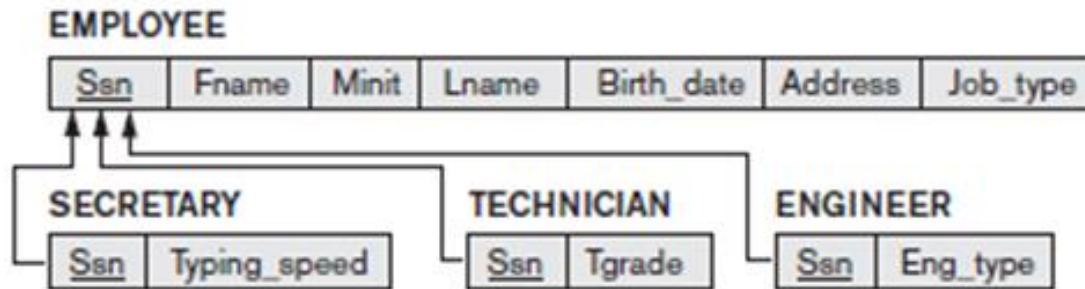
- For each multivalued attribute
 - Create new relation R with attribute to hold multivalued attribute values
 - If multivalued attribute is composite, include its simple components
 - Add attribute(s) for primary key of relation schema for entity or relationship type to be foreign key for R
 - Primary key of R is the combination of all its attributes

(d) DEPT_LOCATIONS

<u>Dnumber</u>	<u>Dlocation</u>
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OPTIONS FOR MAPPING SPECIALIZATION OR GENERALIZATION

- For *any* specialization (total or partial, disjoint or overlapping)
 - Separate relation per superclass and subclasses
 - Single relation with at least one attribute per subclass
 - Introduce a Boolean attribute if none specific for subclass



or

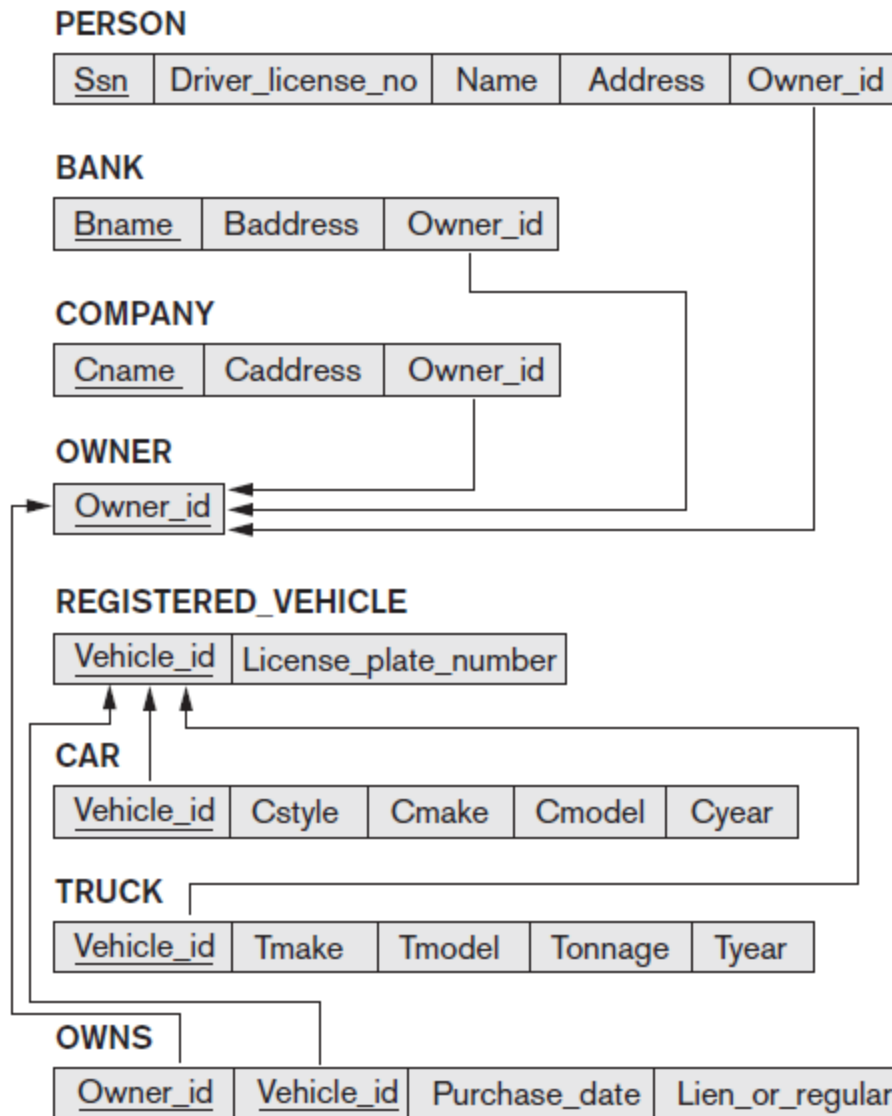


SPECIALIZATION OPTIONS (CONT'D)

- For *total specializations* (and generalizations) *only*
 - Separate relation per subclass relations only
 - Overlapping subclasses will result in multiple tuples per entity
- For *disjoint specializations only*
 - Single relation with one type attribute
 - **Type** or **discriminating attribute** indicates subclass of tuple
 - Might require many NULL values if several specific attributes exist in subclasses

MAPPING UNION TYPES

- Create relation schema to represent union type (generalization)
- Specify a new key attribute
 - **Surrogate key**
- Example: *Owner* and *Registered Vehicle*



SUMMARY

- Algorithm for ER-to-relational mapping

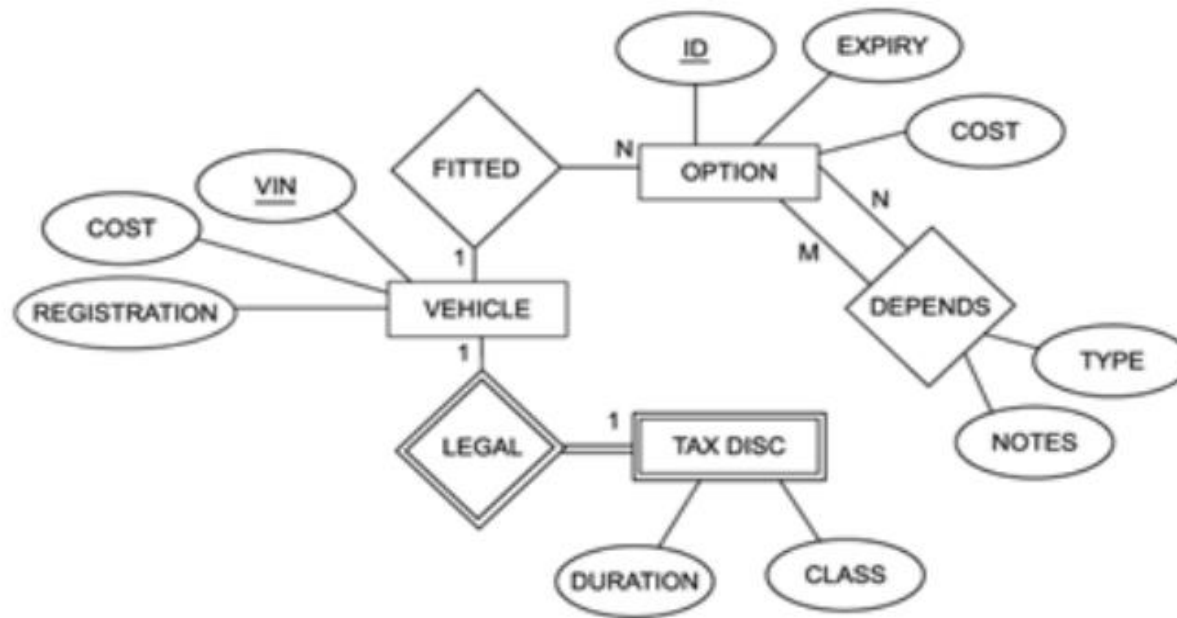
Table 9.1 Correspondence between ER and Relational Models

ER MODEL	RELATIONAL MODEL
Entity type	<i>Entity</i> relation
1:1 or 1:N relationship type	Foreign key (or <i>relationship</i> relation)
M:N relationship type	<i>Relationship</i> relation and <i>two</i> foreign keys
<i>n</i> -ary relationship type	<i>Relationship</i> relation and <i>n</i> foreign keys
Simple attribute	Attribute
Composite attribute	Set of simple component attributes
Multivalued attribute	Relation and foreign key
Value set	Domain
Key attribute	Primary (or secondary) key

- Extensions for mapping constructs from EER model into relational model

EXERCISE

Translate the following ER Diagram into a relational database schema.



EXERCISE

What ER Diagram might produce the following relational database schema?

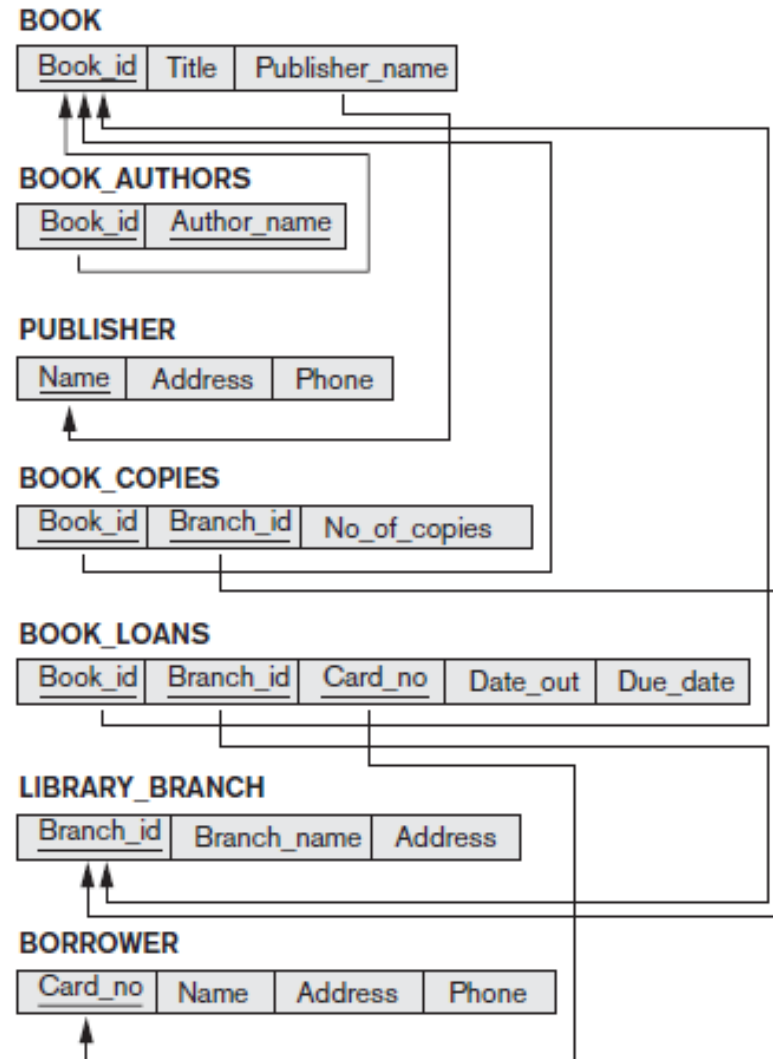


Figure 6.14
A relational database
schema for a LIBRARY
database.