

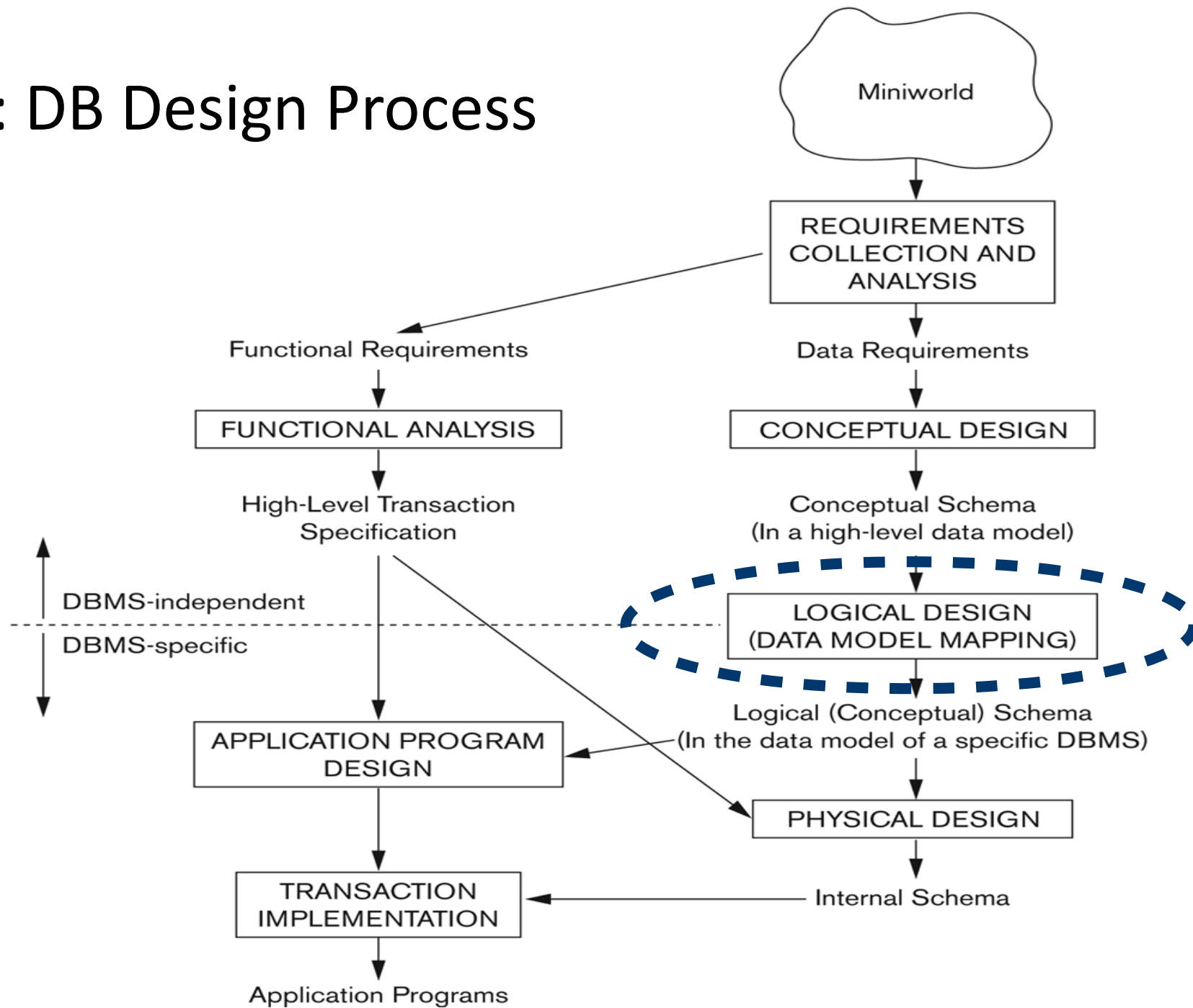
Database Technology

Topic 5: Mapping of EER Diagrams to Relational Databases

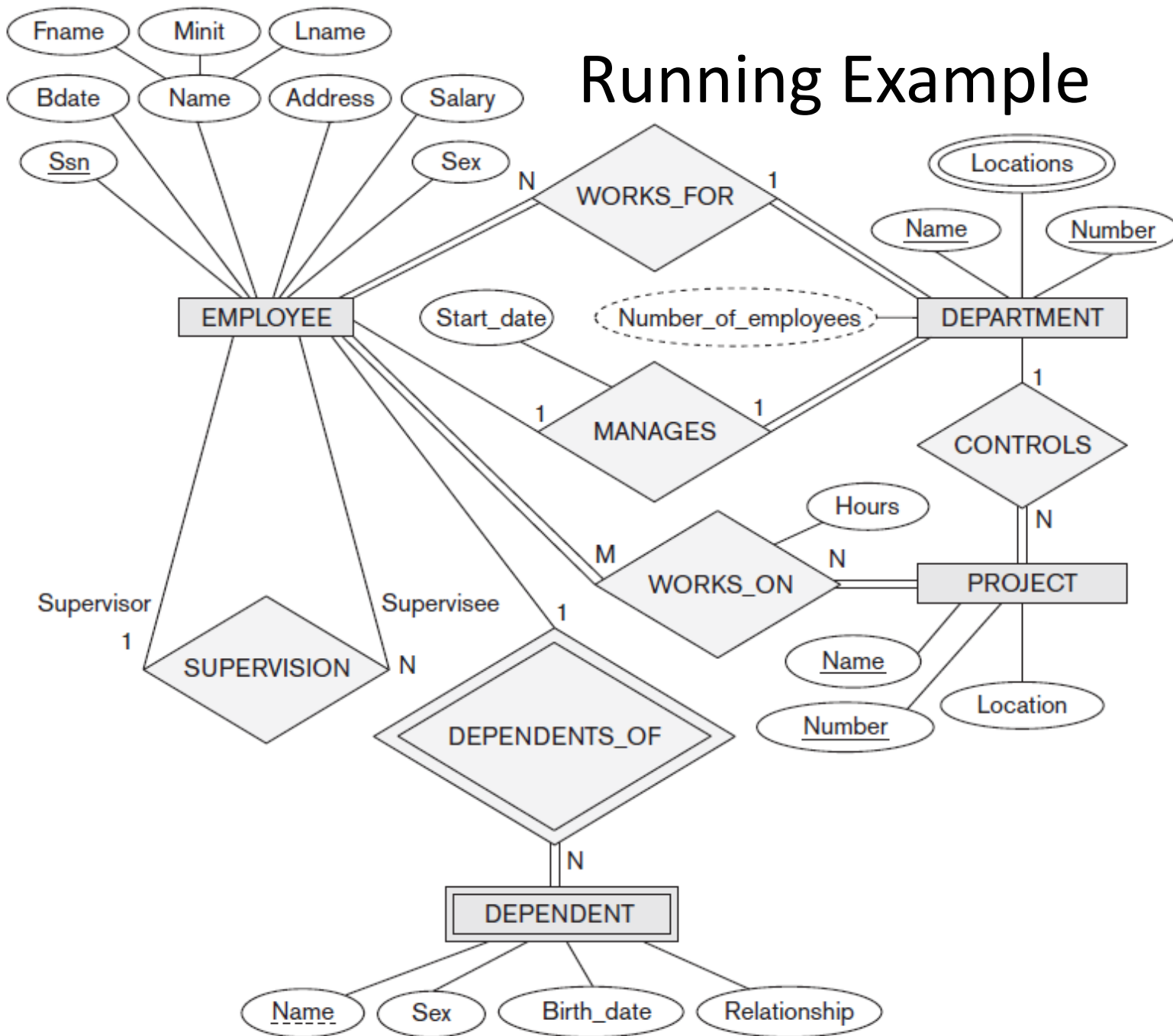
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Recall: DB Design Process



Running Example



Algorithm for Mapping from the ER Model to the Relational Model

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 (e.g., Name of Employee)
 - Example renames some attributes (e.g., Dname), but not needed
 - Pick one of the keys as primary key, declare others to be unique
 - Resulting relations are called **entity relations**
 - Each tuple represents an entity instance

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
 - Include all single-valued attributes of the weak entity type *and of the identifying relationship* as attributes of R
 - Include primary key attribute of identifying entity as foreign key attribute of R
 - Primary key of R is primary key of identifying entity together with partial key from R
- Omit the identifying relationship when subsequently translating (other) relationship types to relation schemas

DEPENDENT

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
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Step 3: 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:

1. 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

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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- Add single-valued attributes of relationship type as attributes of R

Step 3: 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:

2. Merged relationship approach

- Possible if both participations are total
- Combine the two relation schemas into one, which will also represent R
- Make one of the primary keys unique instead

3. 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, the other one as unique

- Add single-valued attributes of relationship type as attributes of R

Step 4: 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** (next slide)

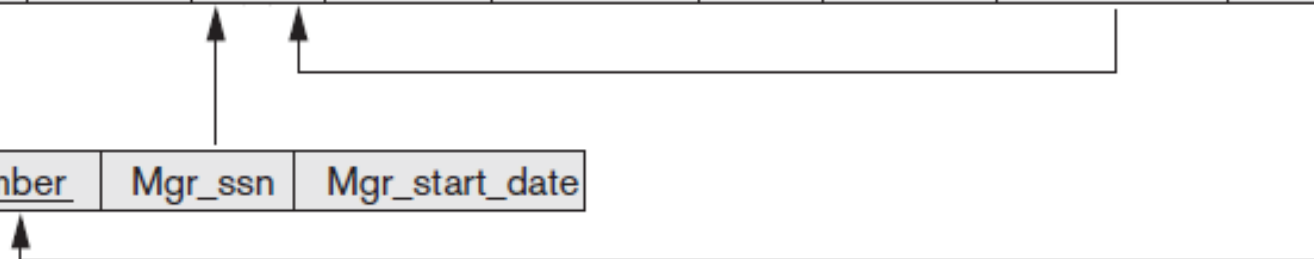
- Include single-valued attributes of relationship type as attributes

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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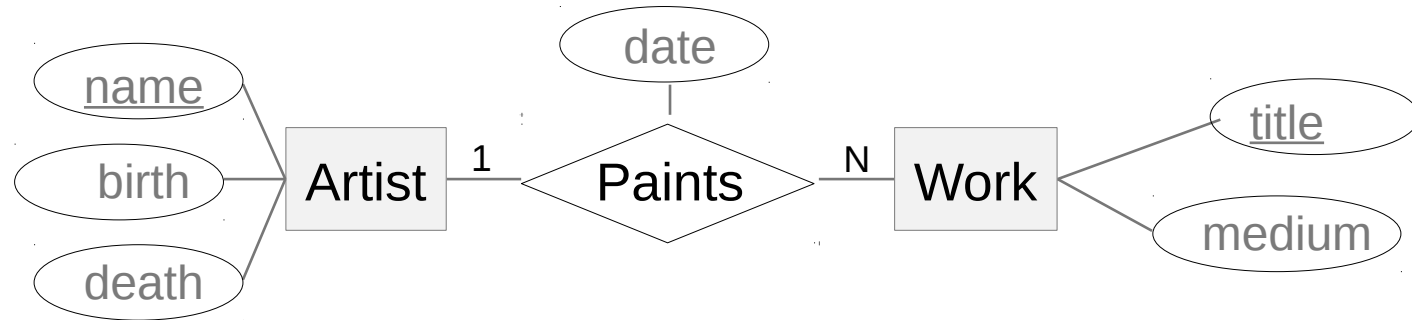


Step 4: Binary 1:N Relationship Types

- **Foreign key approach**
- **Relationship relation approach**
 - Create new relation schema for relationship type with two foreign key attributes being copies of both primary keys
 - Declare the foreign key attribute for the relation schema corresponding to the participating entity type *on the N-side* as primary key
- Include single-valued attributes of relationship type as attributes

Quiz

Consider the given ER diagram and relational DB schema



Artist(name,birth,death), Work(title,medium)

The Paints relationship can be represented by:

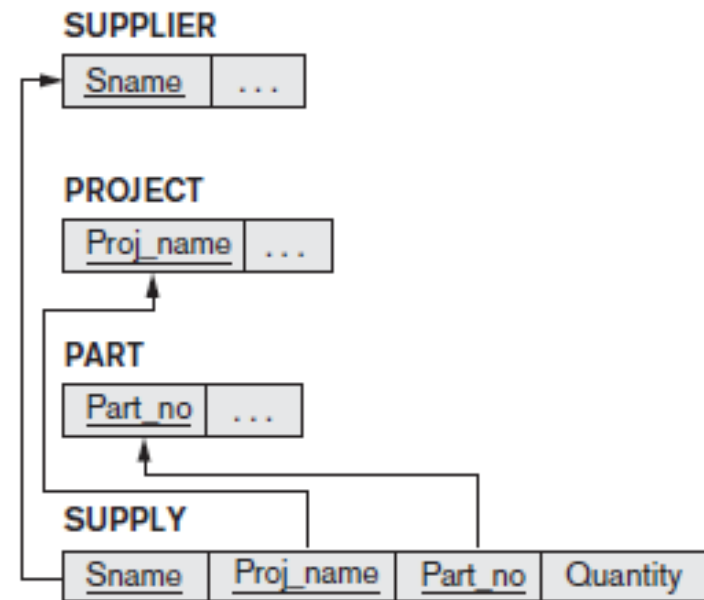
- A. introducing a third schema: Paints(name,title,date)
- B. extending the Work schema to be Work(title,medium,name,date)
- C. extending the Artist schema to be Artist(name,birth,death,title,date)
- D. either A or B above
- E. any of A, B, or C above

Step 5: 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 the primary key of S
 - Include any simple attributes of relationship type in S

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
 - Add 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 type or relationship type to be foreign key for R
 - Primary key of R is the combination of *all* its attributes

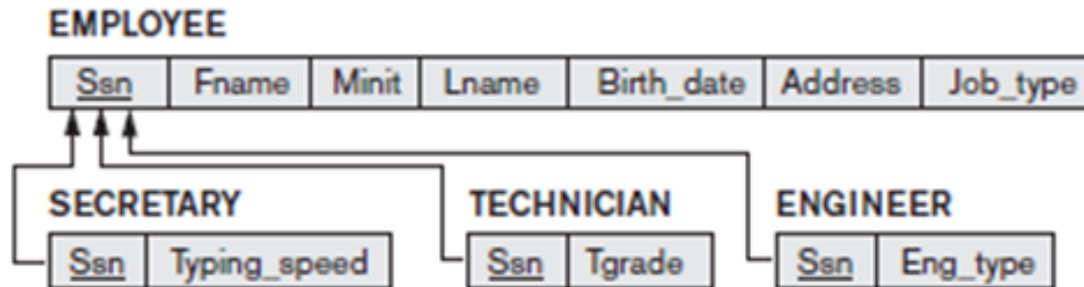
DEPT_LOCATIONS

<u>Dnumber</u>	<u>Dlocation</u>
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Mapping Constructs from the EER Model

Options for Mapping Specialization/Generalization

- For *any* specialization (total or partial, disjoint or overlapping)
 1. Separate relation per supertype and subtypes



2. Single relation with Boolean type attributes for every subtype
 - Add all attributes of all subtypes

Options for Mapping Specialization/Generalization (cont'd)

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

EMPLOYEE

<u>Ssn</u>	Fname	Minit	Lname	Birth_date	Address	Job_type	Typing_speed	Tgrade	Eng_type
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Summary and Example

Summary

- Algorithm for ER-to-relational mapping

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

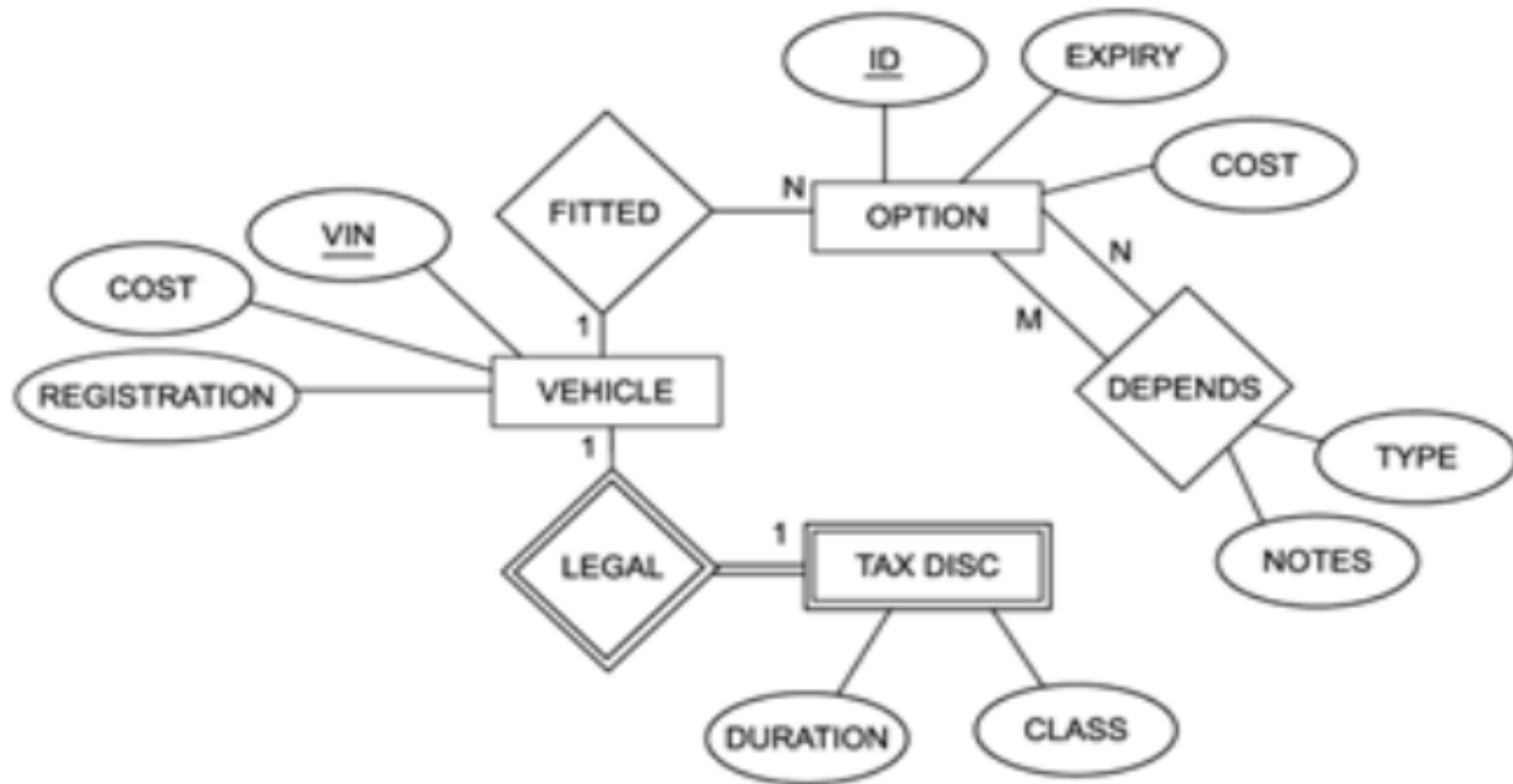
Domain

Primary (or secondary) key

- Extensions for mapping constructs from EER model

Exercise

Translate the following ER Diagram into a relational database schema.



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