Database Technology

Topic 5:
Mapping of EER Diagrams to Relational Databases

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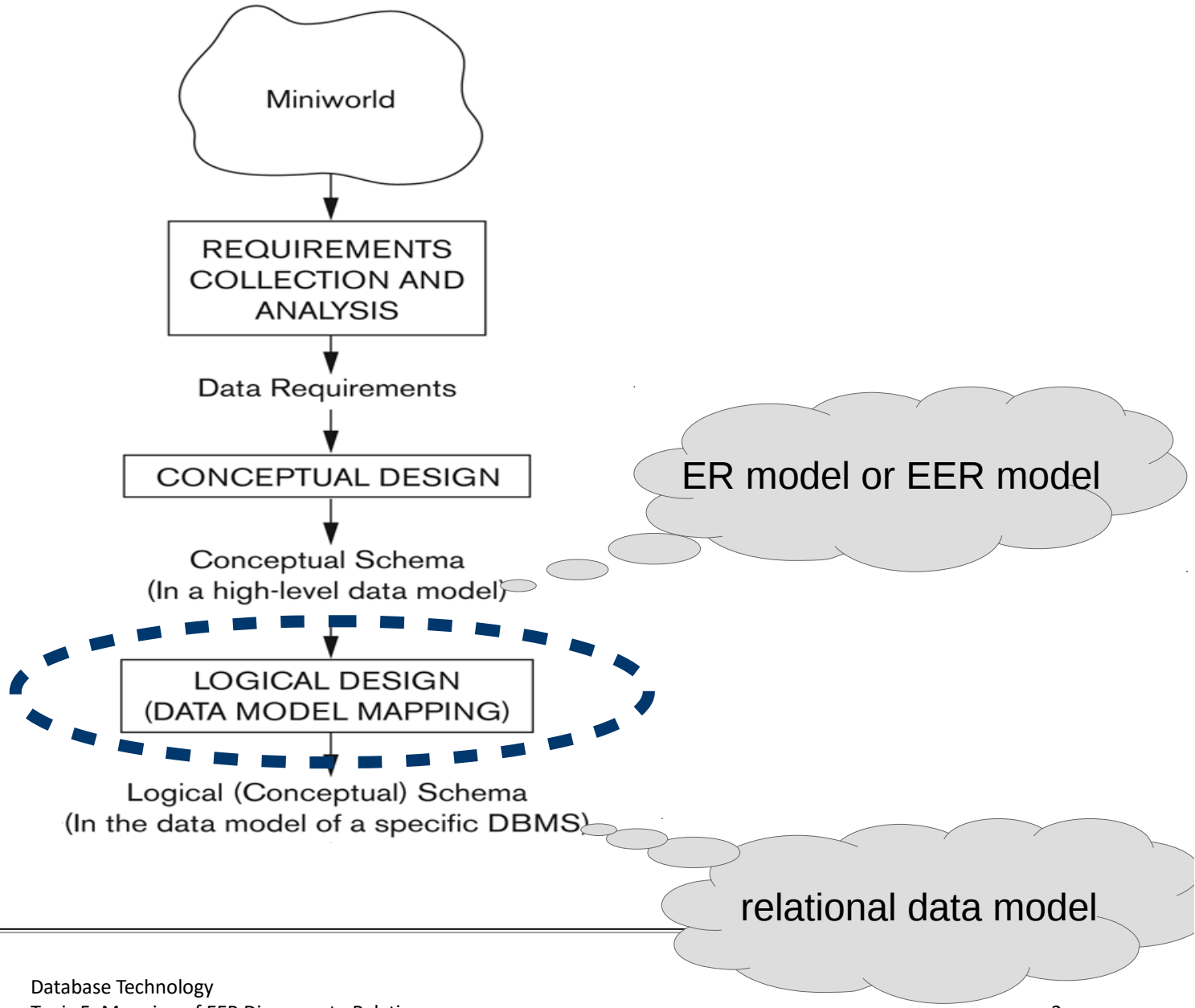
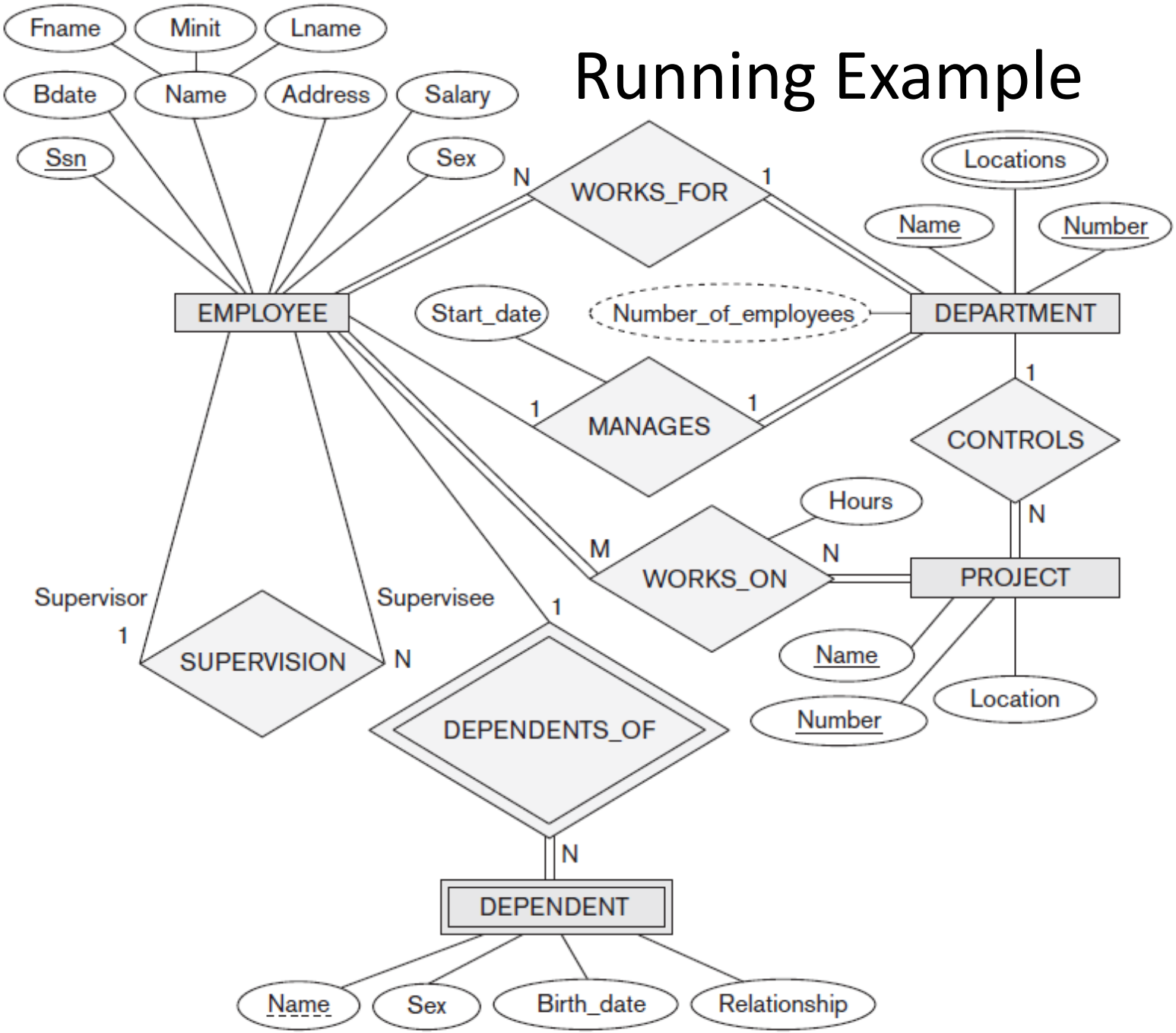
Recall: DB Design Process



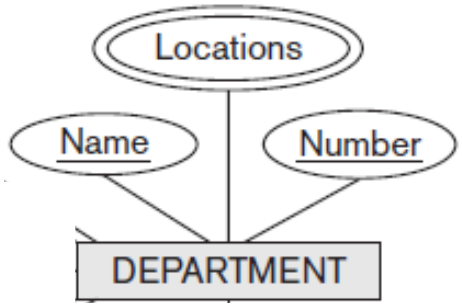
Running Example



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* attribute of *Employee*)
  - Ignore multivalued attributes at this point (e.g., *Locations* attribute)
  - 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

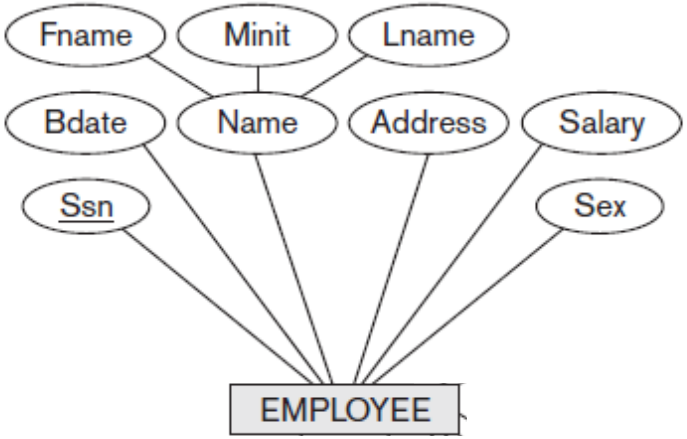


DEPARTMENT

Dname	Dnumber

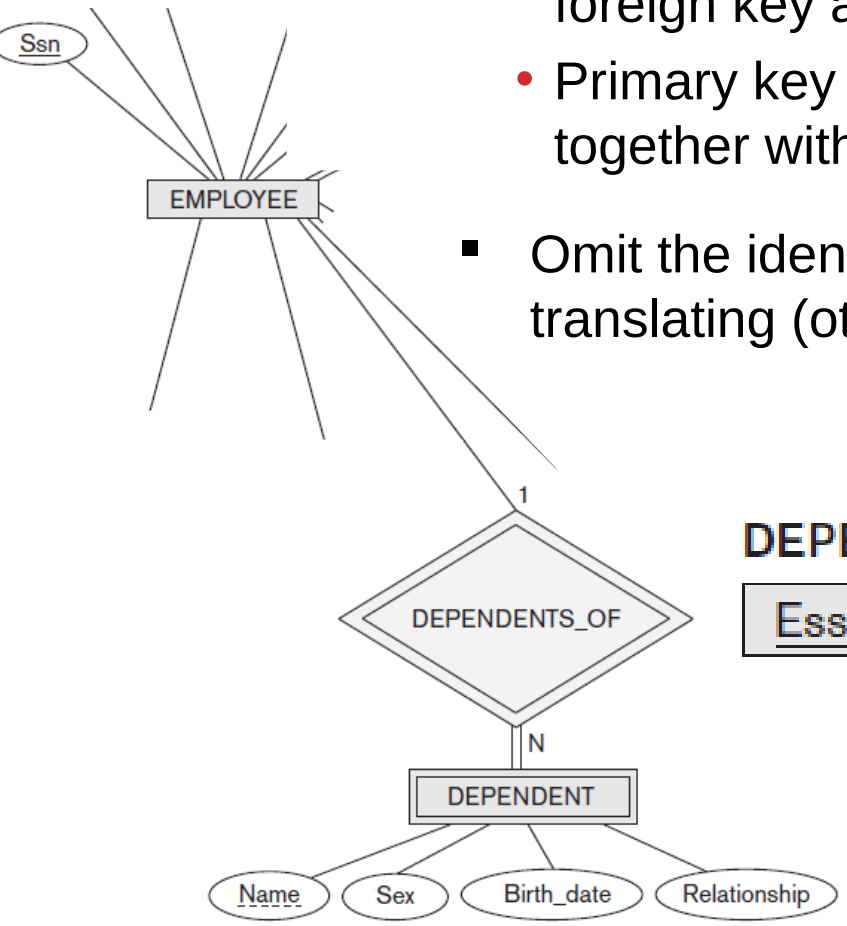
EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary



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



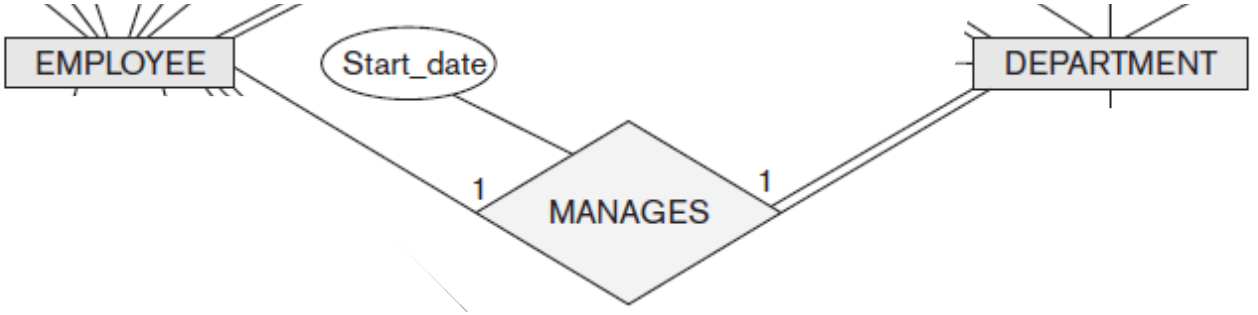
DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

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



EMPLOYEE

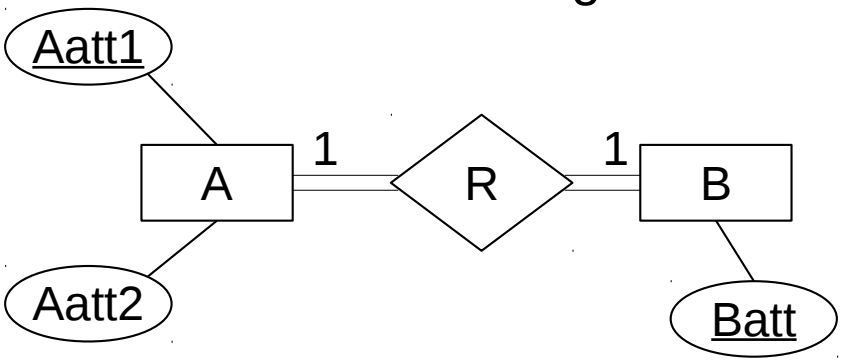
Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

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



AB | Aatt1 | Aatt2 | Batt

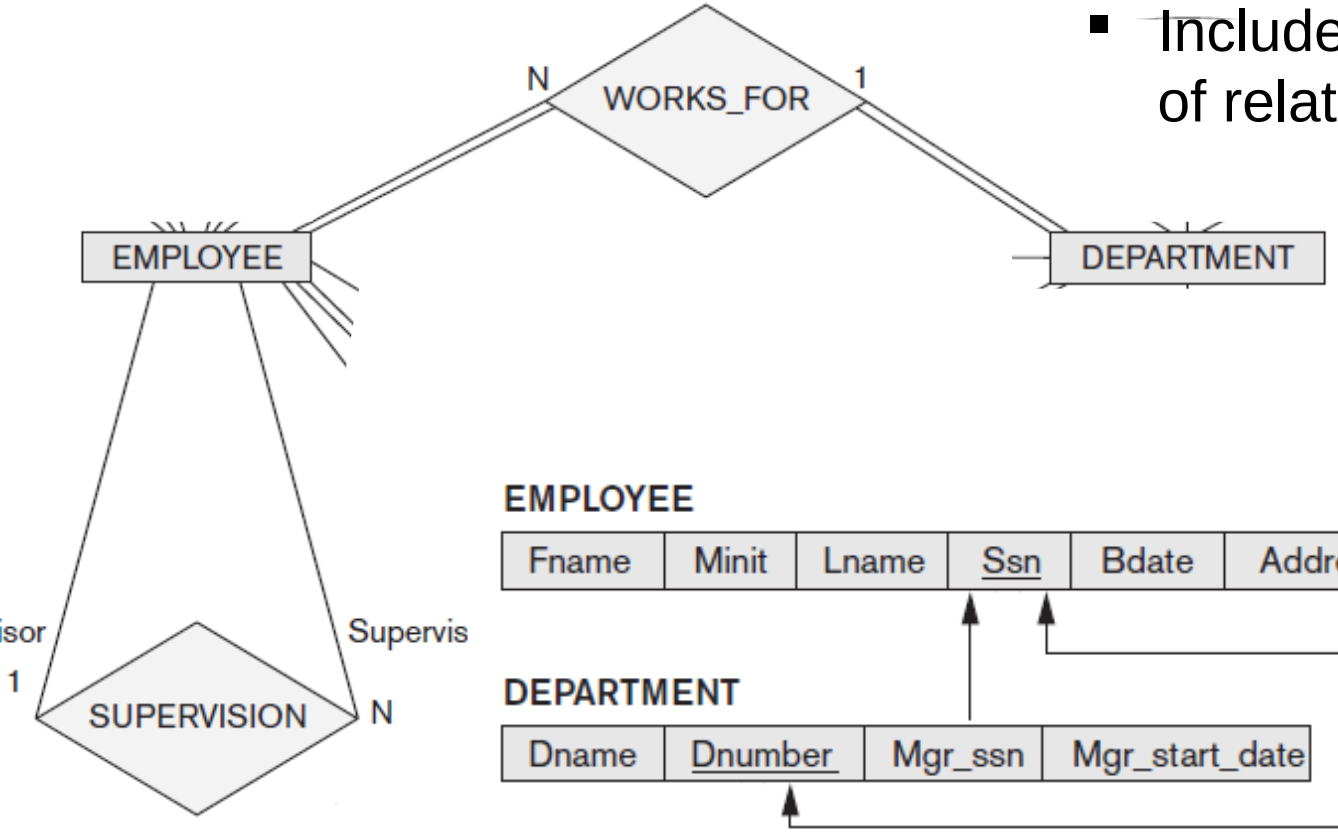
Step 3: Binary 1:1 Relationship Types

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

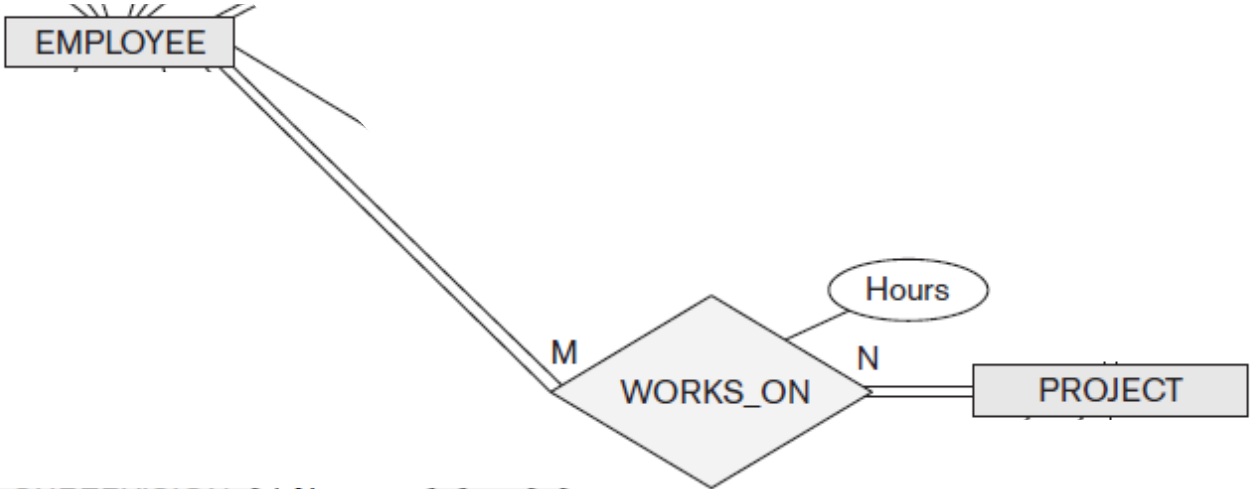


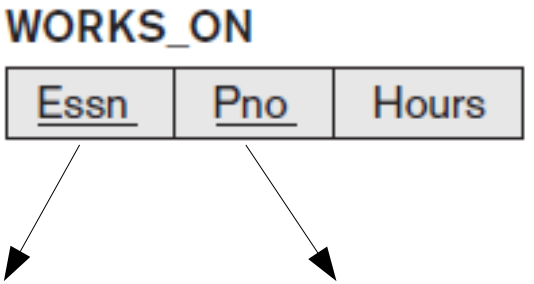
Step 4: Binary 1:*N* Relationship Types

- **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

Step 5: Binary *M*:*N* and Higher Order Relationship Types

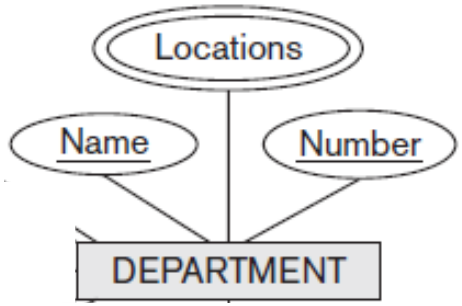
- For each binary *M*:*N* relationship type or ternary or higher order relationship type, create a new relation *S*
  - Include primary key of participating entity types as foreign key attributes in *S*
  - Make all these attributes the primary key of *S*
  - Include any simple attributes of relationship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

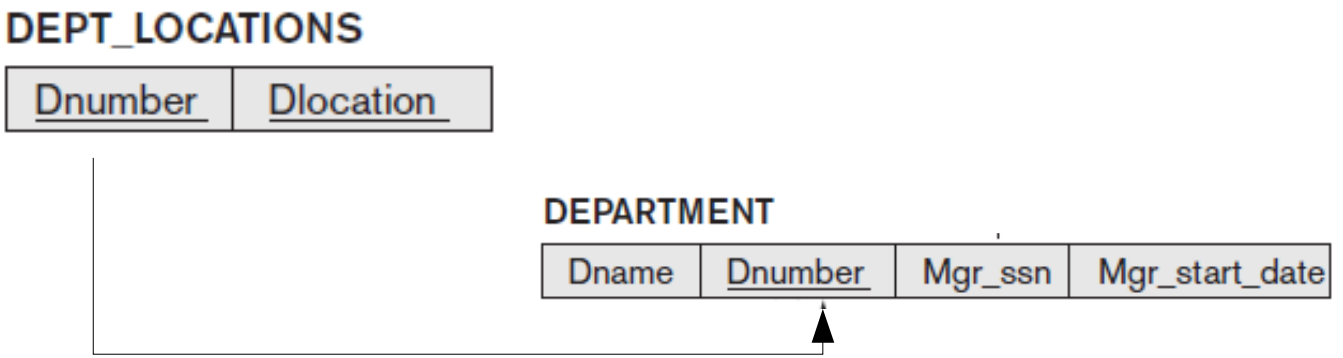




Step 6: Map Multivalued Attributes

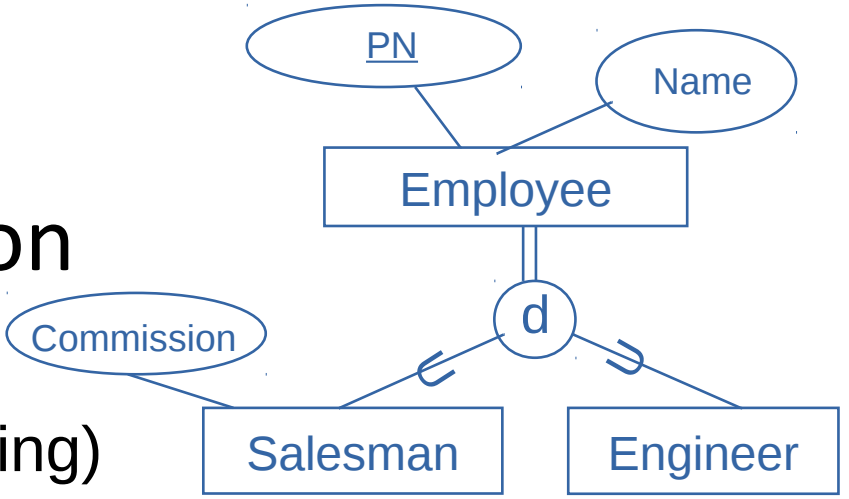
- For each multivalued attribute create new relation *R*
  - Add attribute to hold multivalued attribute values
    - If multivalued attribute is composite, include its simple components
  - Add attribute(s) for primary key of relation schema for entity type or relationship type to be foreign key for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





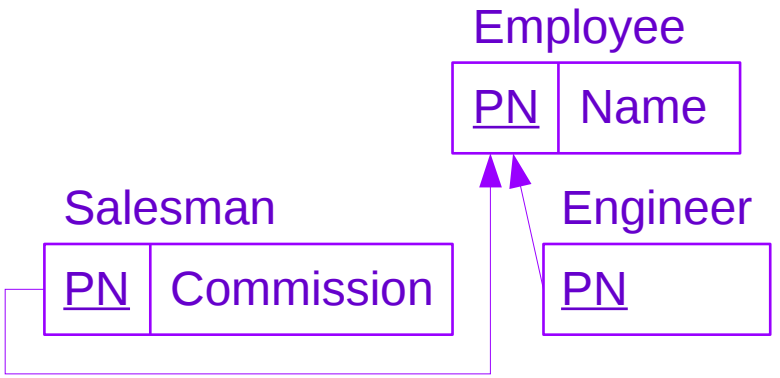
Mapping Constructs from the EER Model

Options for Mapping Specialization/Generalization

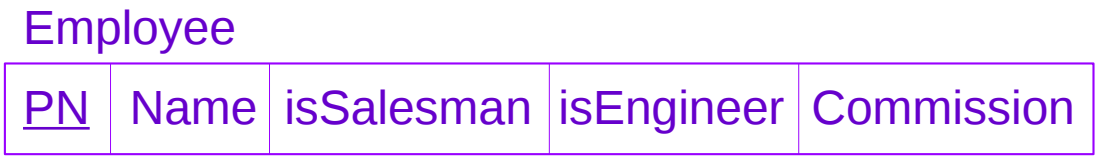


- For *any* specialization
  (total or partial, disjoint or overlapping)

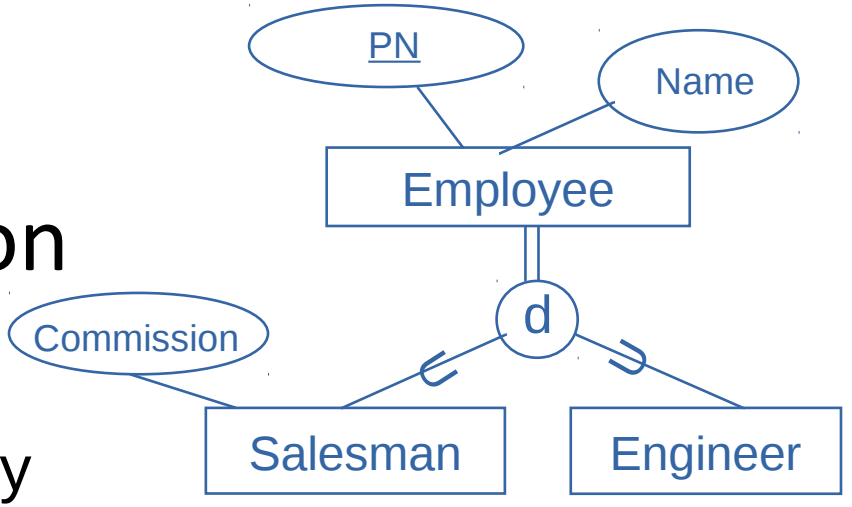
1. Separate relation per supertype and subtypes



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



Options for Mapping Specialization/Generalization



- For *total specializations only*
  - Separate relation per subclass only
  - Overlapping subtypes will result in multiple tuples per entity

Salesman

PN	Name	Commission

Engineer

PN	Name

- 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

PN	Name	Type	Commission

Summary and Example

Summary

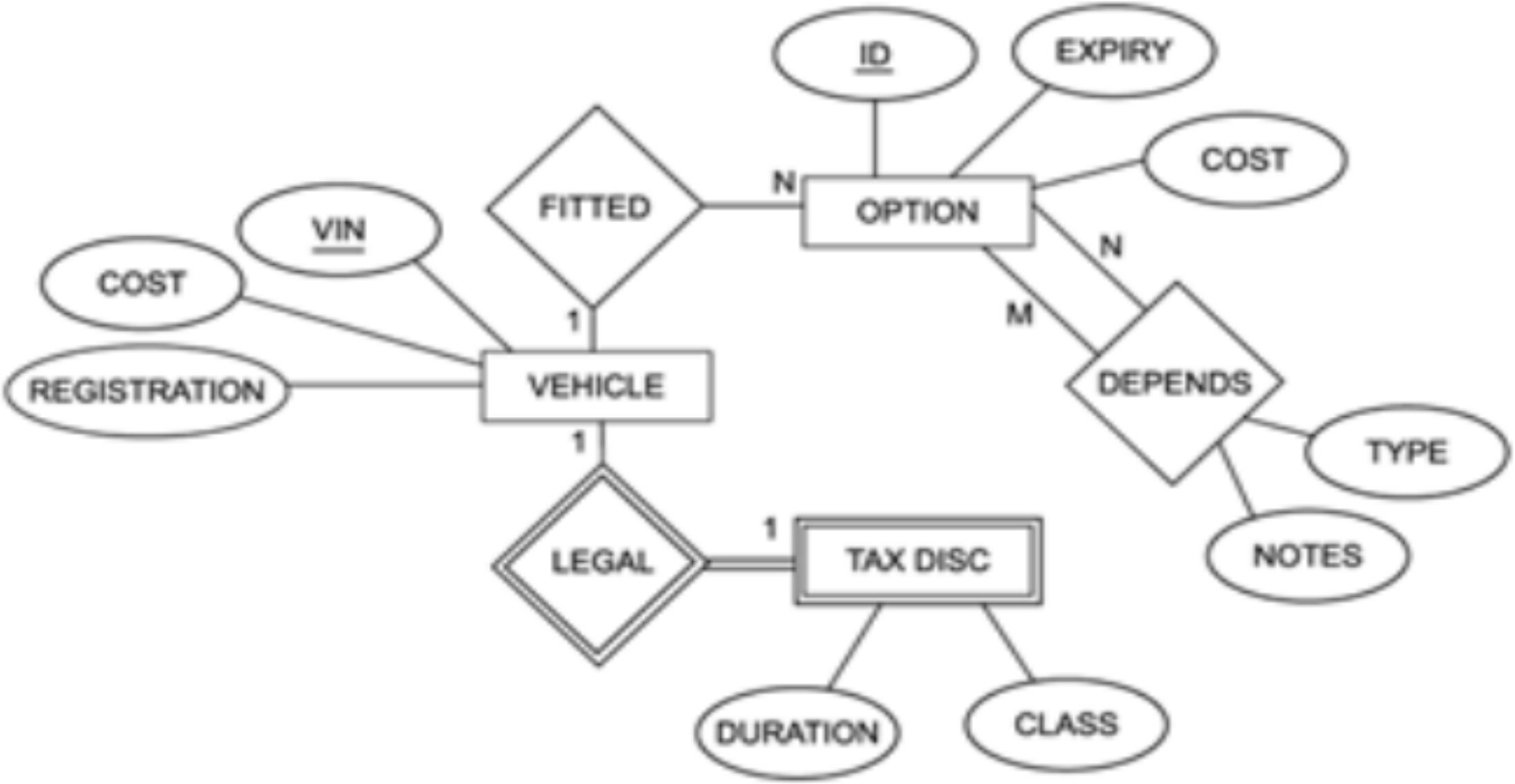
- Algorithm for ER-to-relational mapping

ER MODEL	RELATIONAL MODEL
Entity type	*Entity* relation
1:1 or 1:N relationship type	Foreign key (or *relationship* relation)
M:N relationship type	*Relationship* relation and *two* foreign keys
n-ary relationship type	*Relationship* relation and *n* 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

Exercise

Translate the following ER Diagram into a relational database schema.



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