

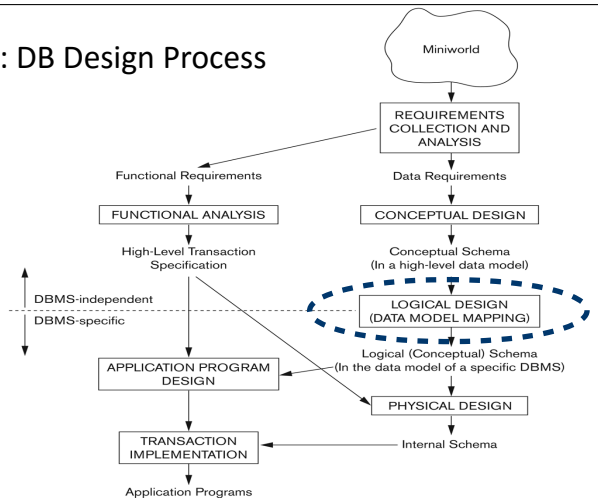
# Database Technology

## Topic 5: Mapping of EER Diagrams to Relational Databases

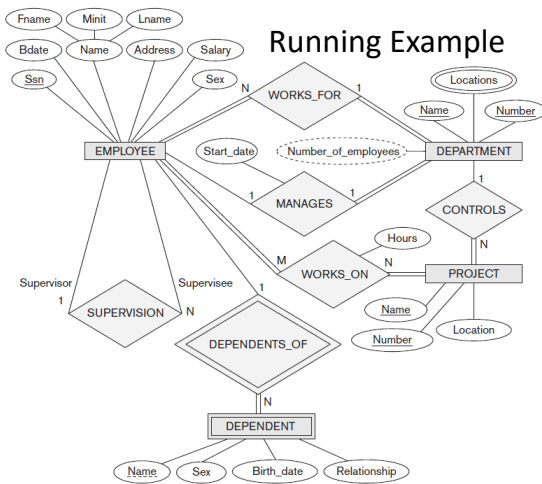
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### Recall: DB Design Process



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## 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 |
|-------|-------|-------|------------|-------|---------|-----|--------|

#### DEPARTMENT

|              |                |
|--------------|----------------|
| <u>Dname</u> | <u>Dnumber</u> |
|--------------|----------------|

#### PROJECT

|              |                |           |
|--------------|----------------|-----------|
| <u>Pname</u> | <u>Pnumber</u> | Plocation |
|--------------|----------------|-----------|

### 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 |
|-------------|-----------------------|-----|-------|--------------|



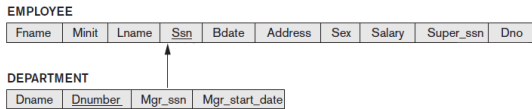
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### Step 3: Binary 1:1 Relationship Types

- 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:
  - 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  $R$

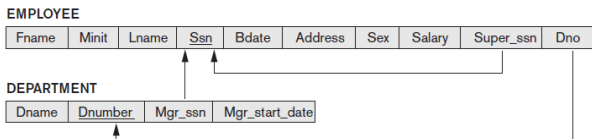
### Step 3: Binary 1:1 Relationship Types

- 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:
  - 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
  - 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

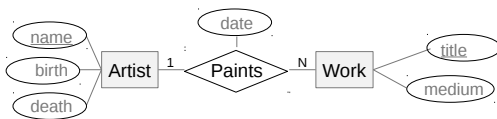


### Step 4: Binary 1:N Relationship Types

- 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

### Quiz

Consider the given ER diagram and relational DB schema



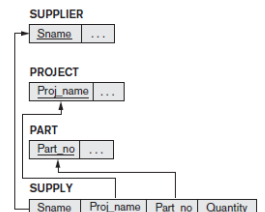
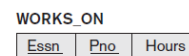
Artist(name, birth, death), Work(title, medium)

The Paints relationship can be represented by:

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

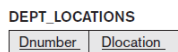
### Step 5: Binary M:N and Higher Order Relationship Types

- 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  $S$



## Step 6: Map Multivalued Attributes

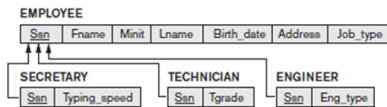
- For each multivalued attribute create new relation  $R$ 
  - Add attribute to hold multivalued attribute values
    - If multivalued attribute is composite, include its simple components
  - Add attribute(s) for primary key of relation schema for entity type or relationship type to be foreign key for  $R$
  - 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)
  - Separate relation per supertype and subtypes



- 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



## 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 <i>relationship</i> relation)            |
| M:N relationship type        | <i>Relationship</i> relation and <i>two</i> foreign keys |
| $n$ -ary relationship type   | <i>Relationship</i> 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.

