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Chapter 9 :-

Relational Database Design by ER and EER - to - Relational Mapping

ER - to - Relational Mapping Algorithm

The ER-to-Relational Mapping Algorithm consists of the following main steps:

- 1) Mapping of Regular Entity Types
- 2) Mapping of Weak Entity Types
- 3) Mapping of Binary 1:1 Relationship Types

- 4) Mapping of Binary 1:N Relationship Types

- 5) Mapping of Binary M:N Relationship Types

- 6) Mapping of Multivalued Attributes

- 7) Mapping of N-ary Relationship types, $n \geq 2$

1) Mapping of Regular Entity Types

→ For each regular (strong) entity type E in the ER diagram

create a relation R that includes all the simple attributes of the entity E .

→ Choose one of the key attributes of entity E as the primary key for relation R .

Example:

EMPLOYEE

Fname	Minit	Lname	<u>SSN</u>	Bdate	Address
Sex	Salary				

DEPARTMENT

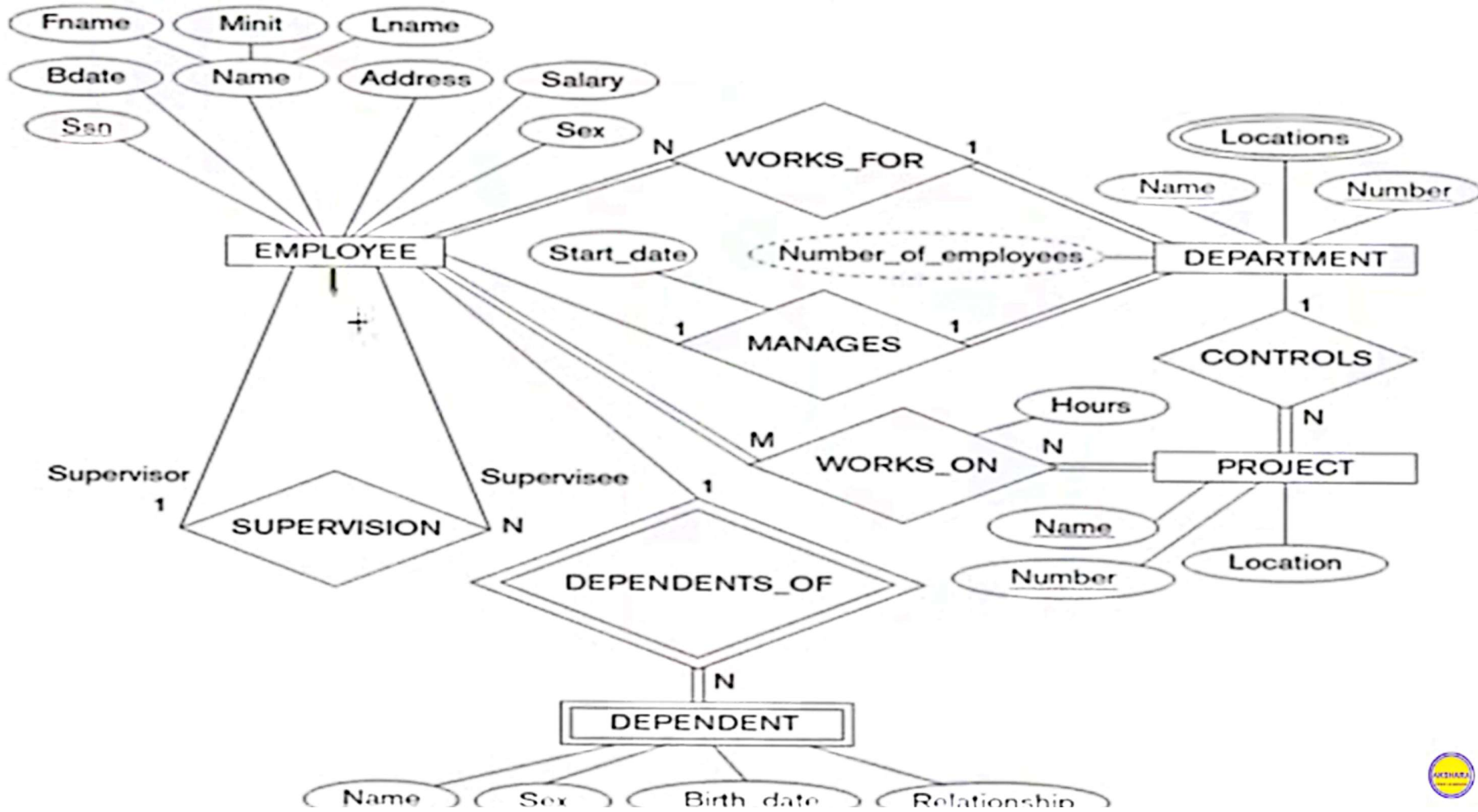
<u>Dname</u>	<u>Dnumber</u>
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PROJECT

<u>Pname</u>	<u>Pnumber</u>	Plocation
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We have created the relations EMPLOYEE, DEPARTMENT and PROJECT corresponding to the regular entities in ER diagram.

The ER concept schema diagram for the COMPANY database.



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2) Mapping of Weak Entity Types

→ For each weak entity type W in the ER schema with owner entity type E , create a relation R and include all simple attributes (or simple components of composite attributes) of W as attributes of R .

→ Also, include the Primary key of owner entity type E as a Foreign key attribute in the relation R .

→ The Primary key of R is the combination of Primary key of the owner entity type E and the partial key of the weak entity type W , if any.

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 as **ESSN**)

→ The primary key of the **DEPENDENT** relation is the combination $\{ESSN, DEPENDENT_NAME\}$ because **DEPENDENT_NAME** is the partial key of **DEPENDENT**.

DEPENDENT

ESSN	Dependent_name	Sex	Bdate	Rxn
FK				
PK				

3) Mapping of Binary 1:1 Relationship 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 relationship R .

→ Choose one of the relation - 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 relationship R in the role of S .

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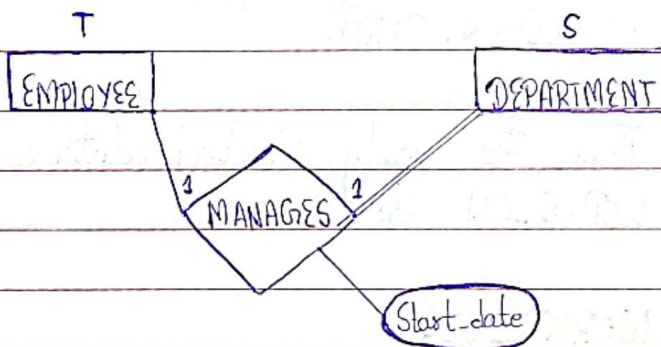
Example:

1:1 relationship MANAGES is mapped by choosing the participating entity type DEPARTMENT to serve in the role of S, because its participation in the MANAGES relationship type is total.

Now DEPARTMENT becomes S and will be modified as

DEPARTMENT

Dname	Dnumber	Mgr_SSN	Mgr_start_date
	PK	FK	



4) Mapping of Binary 1:N Relationship

→ 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 the Primary key of the relation T that represents the other type 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.
- For SUPERVISION we include the primary key SSN of the EMPLOYEE relation as Foreign key in the EMPLOYEE.
- For CONTROLS, we include the primary key NUMBER of the DEPARTMENT relation as Foreign key in the PROJECT.

Thus, the modified relations are:



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EMPLOYEE

Fname	Minit	Lname	Ssn
Bdate	Address	Sex	Salary
Superss	Dno		

PK

FK

PROJECT

Pname	Pnumber	Plocation	Dnum
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PK

FK

5) 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 as attributes of newly created relation S.

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.

→ 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}.

Thus, the newly created relation WORKS_ON is:

WORKS_ON

ESSN	PNO	Hours
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FK

FK

PK

ER-to-Relational Mapping Algorithm

Step 5: Mapping of Binary M:N Relationship Types.

EMPLOYEE

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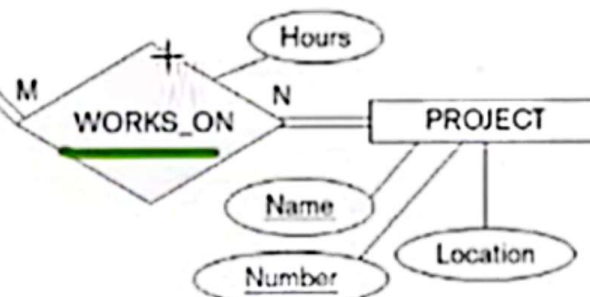


PROJECT

Pname	<u>Pnumber</u>	Plocation	Dnum
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WORKS_ON

<u>Essn</u>	<u>Pno</u>	Hours
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6) Mapping of Multivalued attributes

- For each multivalued attribute A, create a new relation R.
- This new 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.

Example:

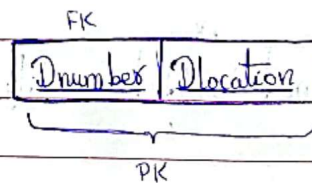
The relation DEPT_LOCATION is created from the multivalued attribute location of DEPARTMENT entity.

- The attribute Dlocation represents the multivalued attribute location of DEPARTMENT, while Dnum as foreign key represents the PK of DEPARTMENT.

- The PK of R is the combination of {Dnum, Dlocation}.

Thus, the newly created relation DEPT-LOCATIONS is:

DEPT-LOCATIONS



7) Mapping of N-ary Relationship Types

- For each n-ary relationship type R, where $n \geq 2$, create a new relation S to represent R.
- Include as FK attributes in S the PK of the relations that represent the participating entity types.
- Also include any simple attributes of the n-ary relationship type as attributes of S.

Example:

The relationship type SUPPLY in the ER.

- This can be mapped to the relation SUPPLY shown

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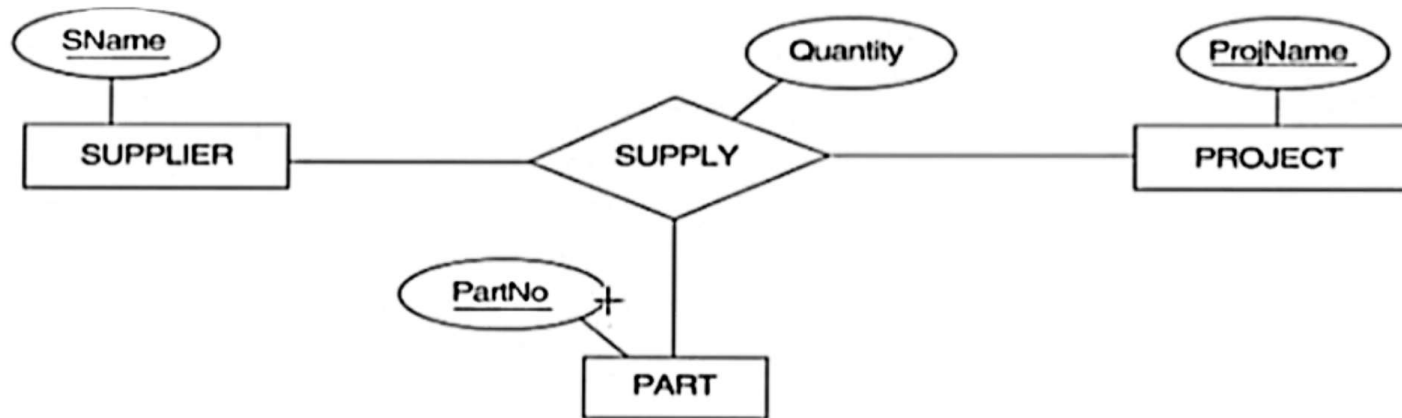
in the relational schema, whose PK is the combination of the three FK {SName, ProjName, PartNo}.

Thus, the SUPPLY relation is:

SUPPLY

FK	FK	FK	
SName	ProjName	PartNo	Quantity
PK			

a)



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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