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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 Relation 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, $n > 2$

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	SSN	Bdate	Address
Sex	Salary				

DEPARTMENT

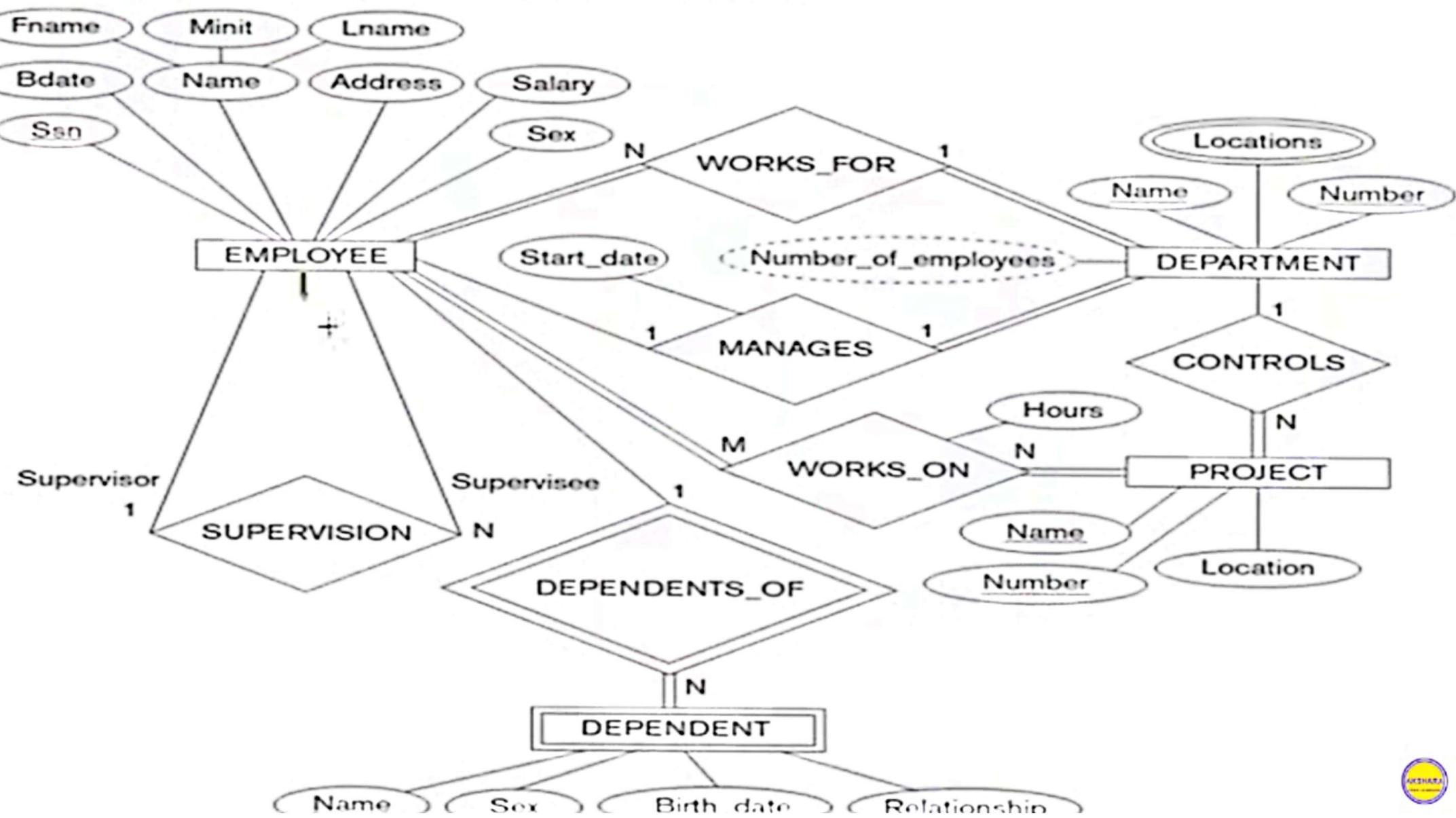
Dname	Dnumber
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PROJECT

Pname	Phumber	Plocation
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We have created the relations EMPLOYEE, DEPARTMENT and PROJECT corresponding to the regular entities in ER diagram.

THE FOLLOWING ER DIAGRAM SHOWS THE STRUCTURE OF 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 relations - 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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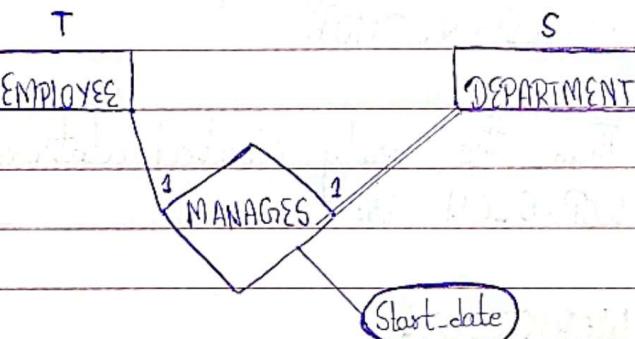
Example:

1:1 relationship MANAGES
is mapped by choosing the
participating entity type DEPART-
MENT 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

<u>Dname</u>	<u>Dnumber</u>	<u>Mgr-SSN</u>	<u>Mgr-start-date</u>
	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	
Pdate	Address	Sex	Salary	
Super_ssn	Dno			
			PK	
			FK	

PROJECT

Pname	Prumber	Plocation	Dnum

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

ER-to-Relational Mapping Algorithm

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

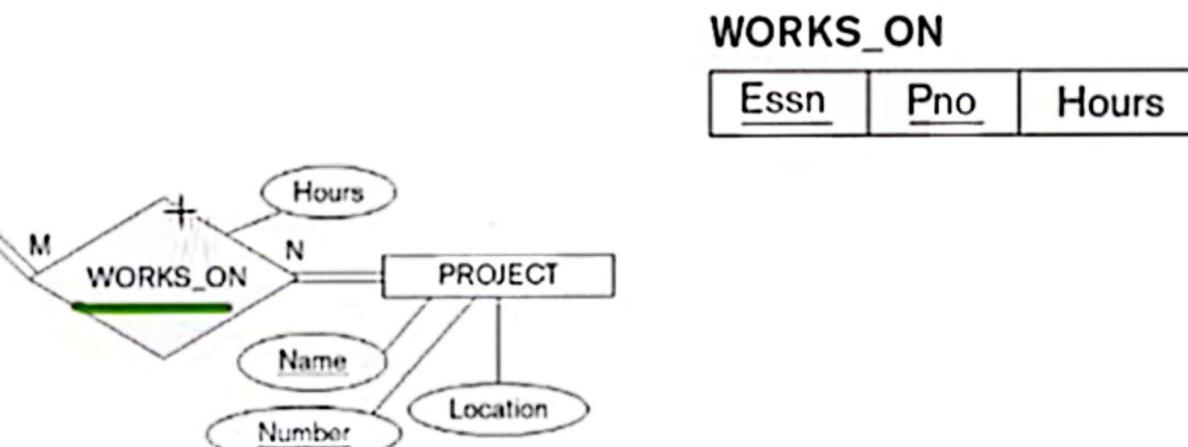
EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
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PROJECT

Pname	Pnumber	Plocation	Dnum
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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_LOCATIONS

- 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

Dnumber	Dlocation
PK	

7) Mapping of N-ary Relationship Types

- For each n-ary relationship type R, where $n > 2$, 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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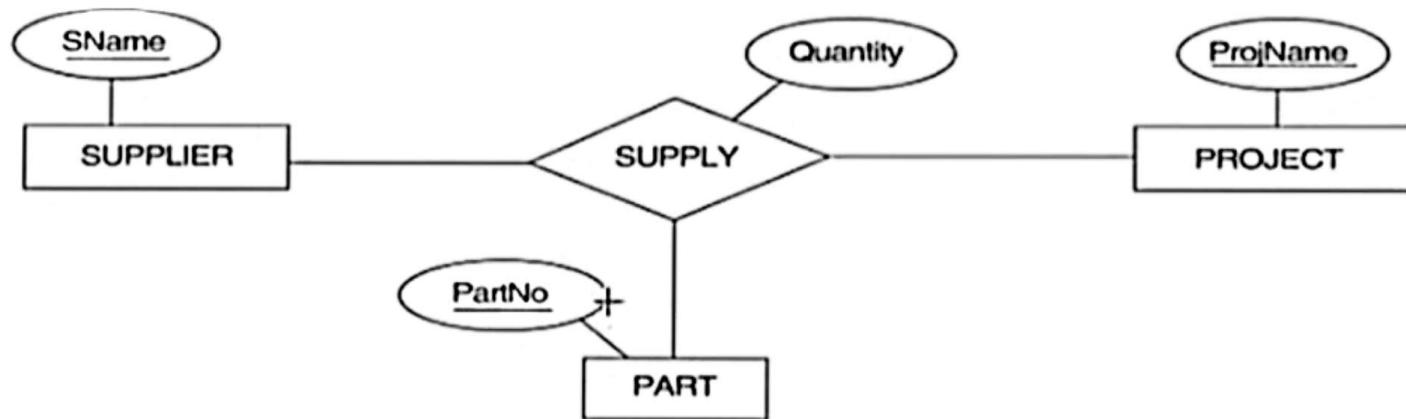
in the relational schema, whose PK is the combination of the three FK {SName, PartNo, PROJName}

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>	<u>PROJNAME</u>	<u>PARTNO</u>	<u>QUANTITY</u>
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