BITS, PILANI – K. K. BIRLA GOA CAMPUS

Database Systems

(CS F212)

by

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

Mapping ER-to-Relational Model

Step 1: Mapping of Strong Entity sets
Step 2: Mapping of Weak Entity sets
Step 3: Mapping Unary Relationship set.
Step 4: Mapping of Binary 1:1 Relationship set
Step 5: Mapping of Binary 1:N Relationship set.
Step 6: Mapping of Binary M:N Relationship set.
Step 7: Mapping of Multivalued attributes.
Step 8: Mapping of N-ary Relationship set.

Mapping EER-to-Relational Model

Step 9: Options for Mapping Specialization or Generalization.

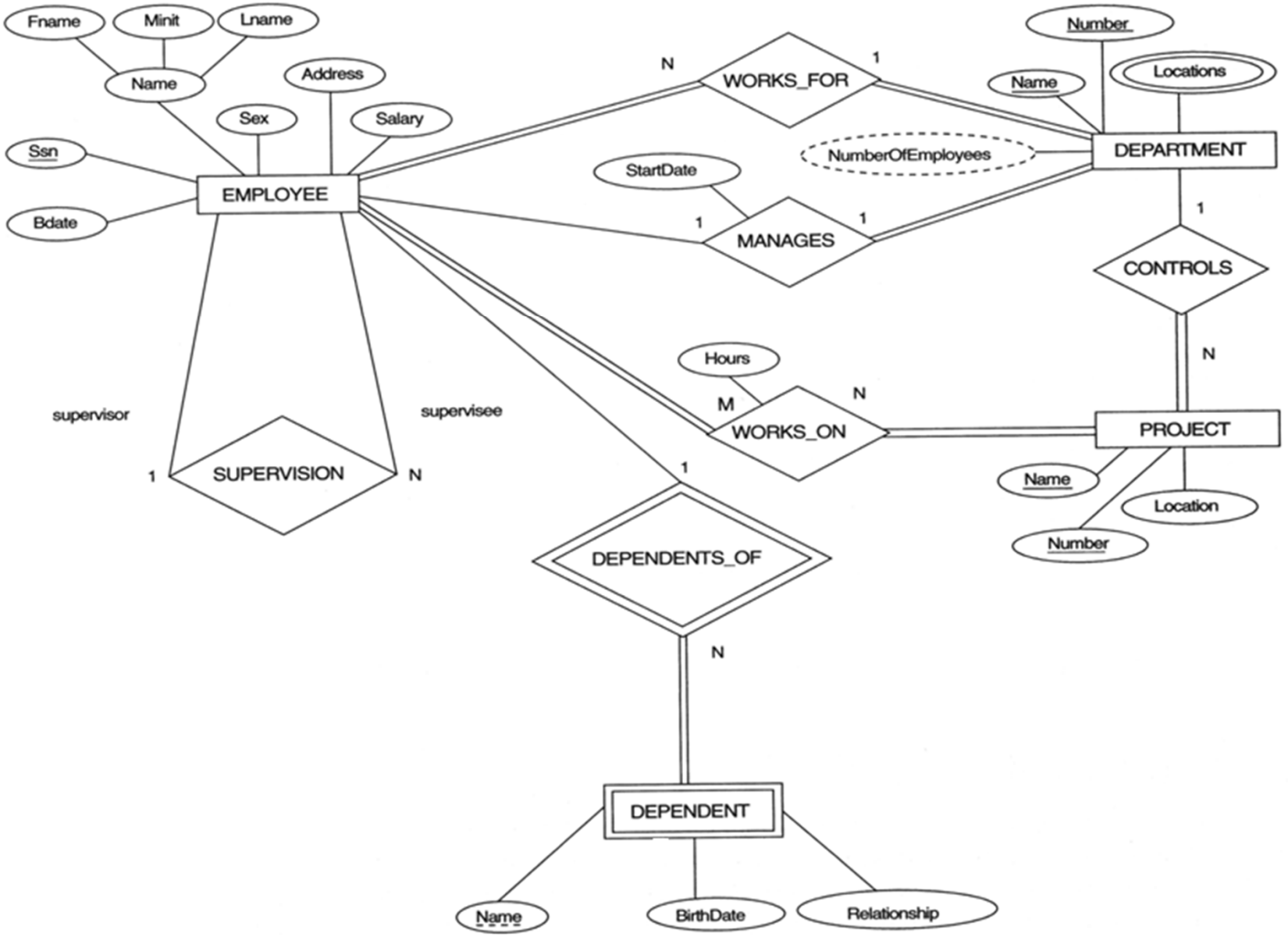
Step 10: Mapping of Union Types (Categories).

Step 1: Mapping of Strong Entity sets

- For each regular (strong) entity set E in the ER schema, create a relation R that includes all the simple attributes of E.

- Choose one of the key attributes of E as the primary key for R. If the chosen key of E is composite, the set of simple attributes that form it will together form the primary key of R.

The ER diagram for the COMPANY database.



Step1 : Example

EMPLOYEE (ssn, fname, mint, lname,
bdate,salary, gender, address)

DEPARTMEMT (dnumber, name)

PROJECT(pnumber, pname, plocation)

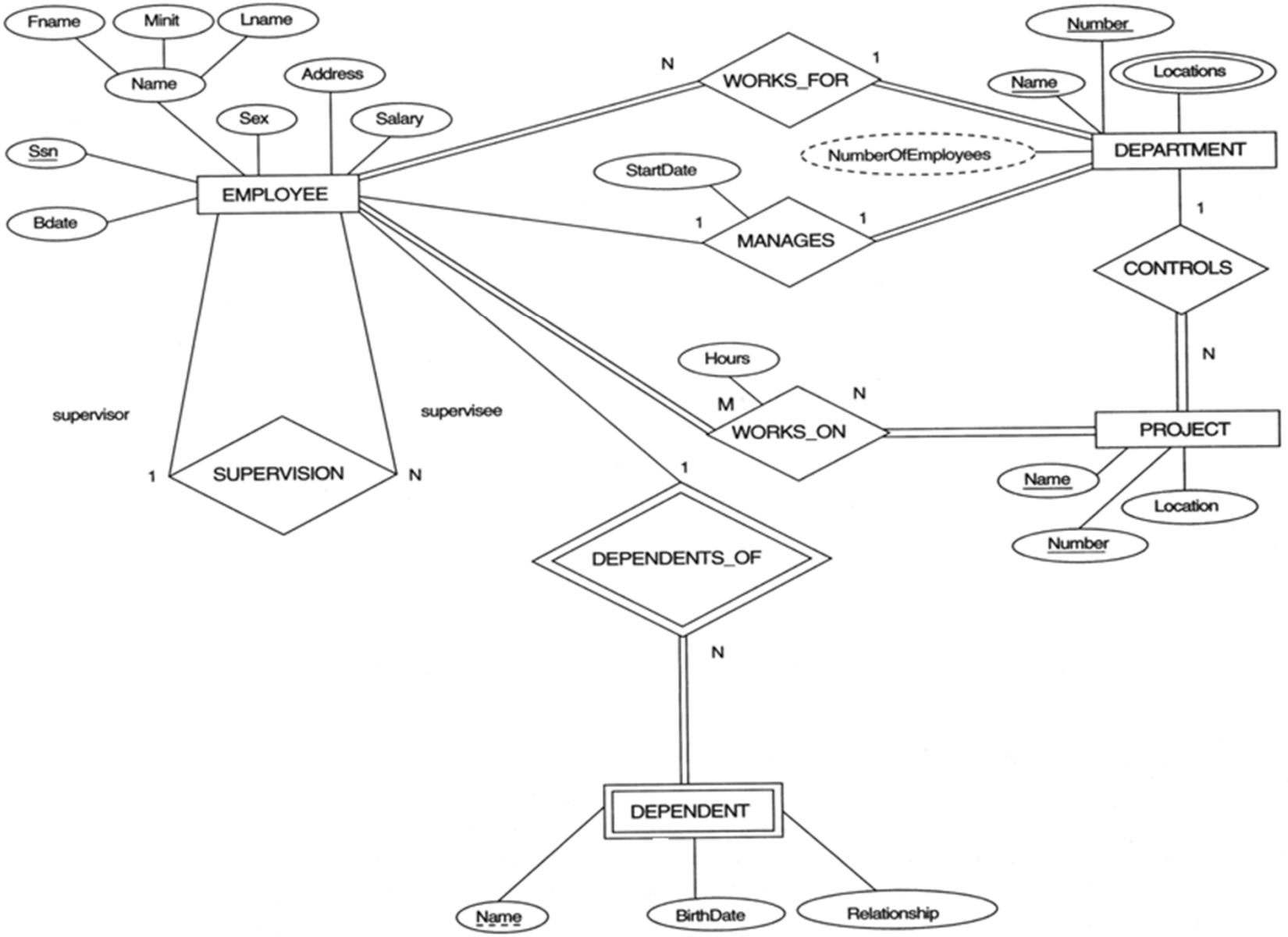
Step 2: Mapping of Weak Entity sets

- 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.

- In addition, include as foreign key attributes of R the primary key attribute(s) of the relation(s) that correspond to the owner entity type(s).

- The primary key of R is the *combination of* the primary key(s) of the owner(s) and the partial key of the weak entity type W, if any.

The ER diagram for the COMPANY database.



Step2 : Example

DEPENDENT (ESSN, depname, bdate, relationship)

Step 3: Mapping unary relationship

Example: Employee is unary relationship

From step 1:

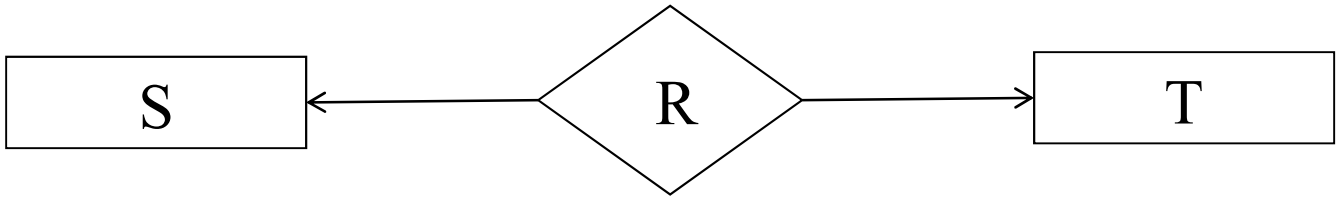
EMPLOYEE (ssn, fname, mint, lname,
bdate,salary, gender, address)

From step 3:

EMPLOYEE (ssn, fname, mint, lname,
bdate,salary, gender, address, superssn)

where superrssn refers to ssn

Step 4: Mapping Binary 1:1 Relationship



Three approaches:

(1) Foreign Key approach **Example**

From step 3:

EMPLOYEE (ssn, fname, mint, lname, bdate, salary, gender, address, superssn)

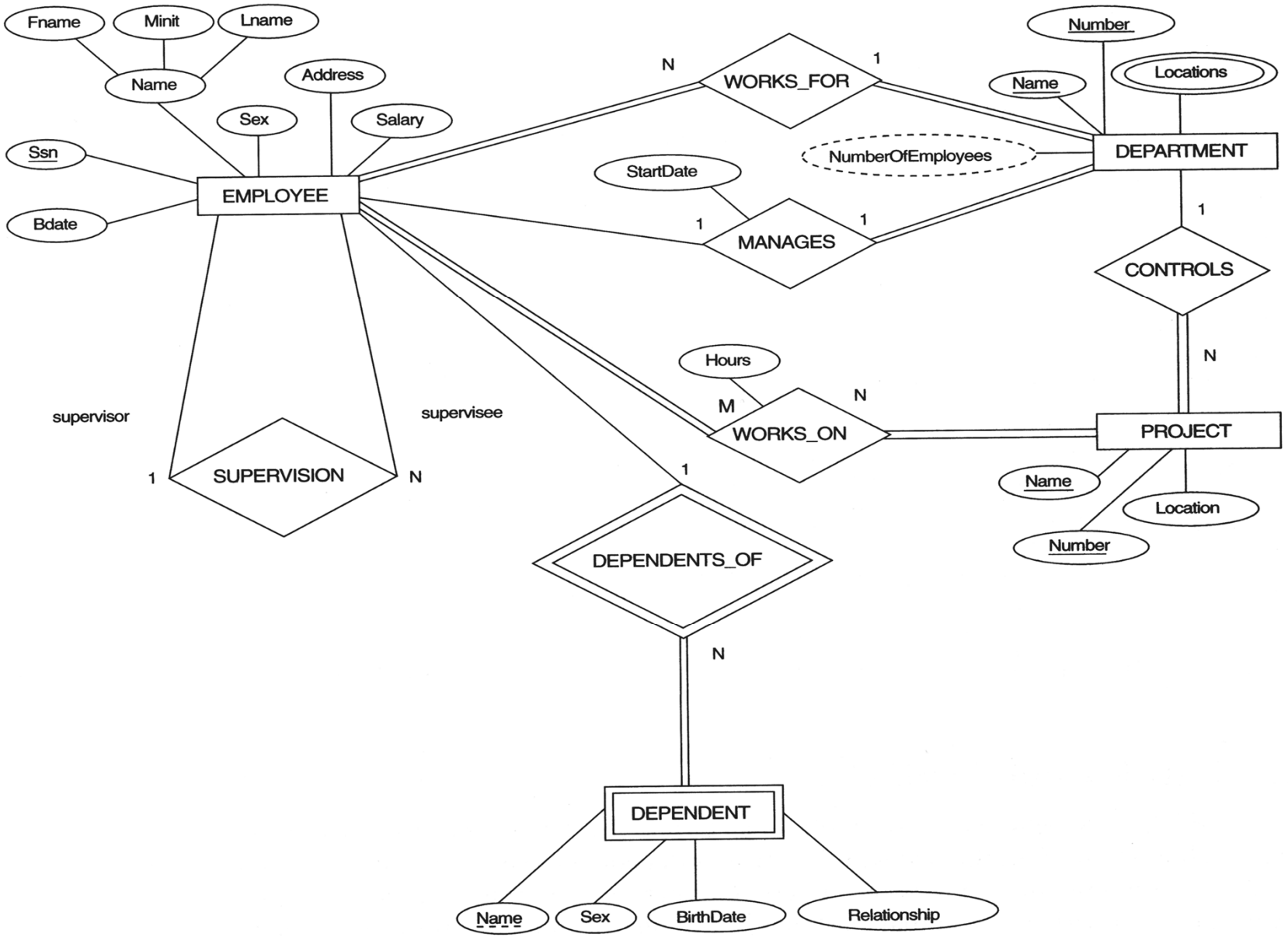
DEPARTMEMT (dnumber, name, mgrstartdate)

From step 4:

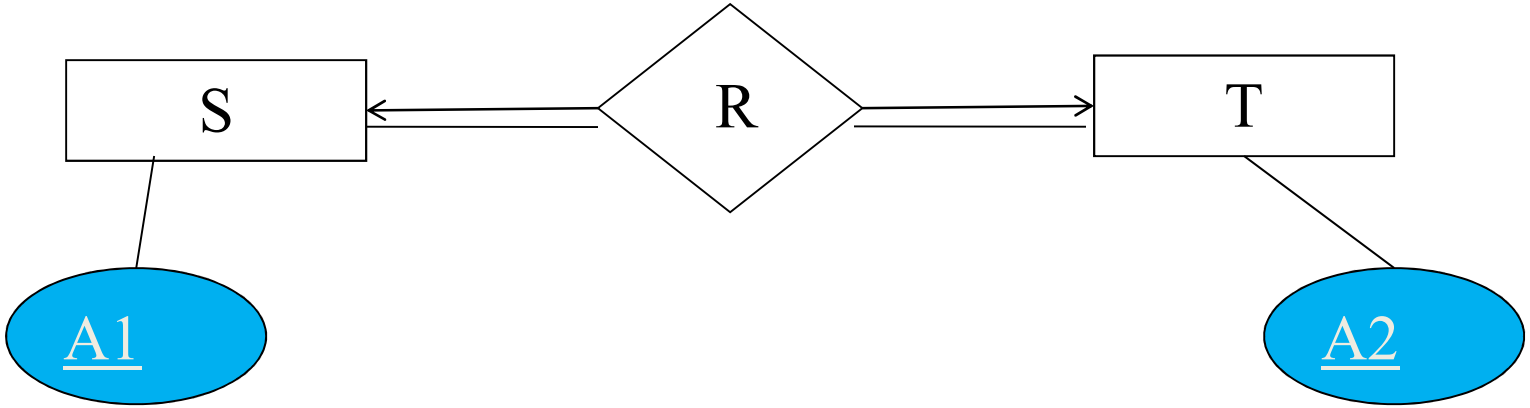
EMPLOYEE (ssn, fname, mint, lname, bdate,salary, gender, address, superssn)

DEPARTMEMT (dnumber, name, mgrssn, mgrstartdate)

The ER diagram for the COMPANY database.



Step 4: Mapping Binary 1:1 Relationship



Second approach: Merged relation option

S(A1, A2, other attributes of S) and

T (A2, other attributes of T)

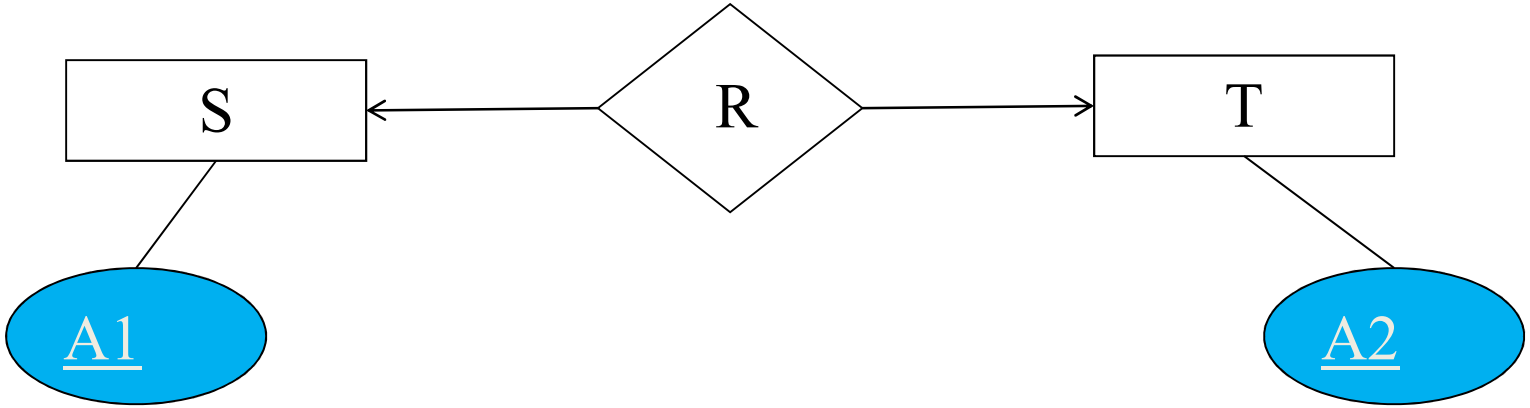
OR

S(A1, other attributes of S) and

T (A2, A1 other attributes of T)

No need to create relation R

Step 4: Mapping Binary 1:1 Relationship



Third approach

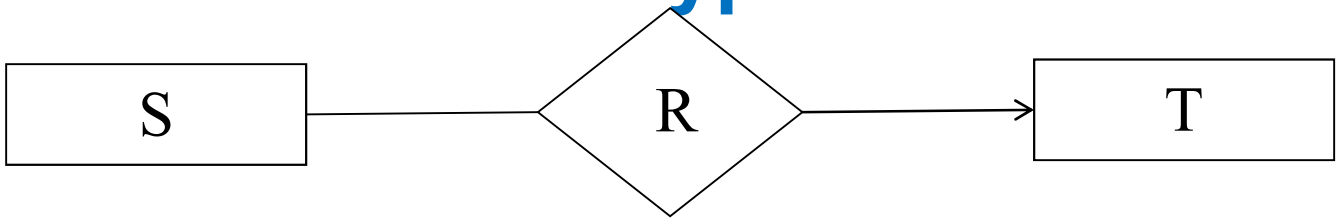
Cross-reference or relationship relation option

S (A1, other attributes of S) and

T (A2, other attributes of T) and

R (A1, A2 other attributes of R)

Step 5: Mapping of Binary 1:N Relationship Types.



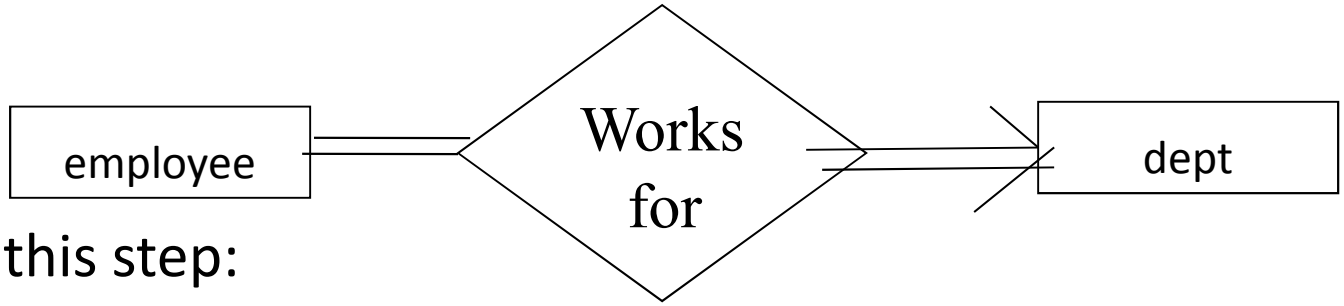
- For each regular binary 1:N relationship type R, identify the relation S that represent the participating entity type at the N-side of the relationship type.
- Include as foreign key in S the primary key of the relation T that represents the other entity type participating in R.
- Include any simple attributes of the 1:N relation type as attributes of S.

Step 5: Mapping of Binary 1:N Relationship Types.

Example: From previous step:

EMPLOYEE (ssn, fname, mint, lname, bdate,salary, gender, address)

DEPARTMEMT (dnumber, name, mgrssn, mgrstartdate)



From this step:

EMPLOYEE (ssn, fname, mint, lname, bdate,salary, gender, address, dno)

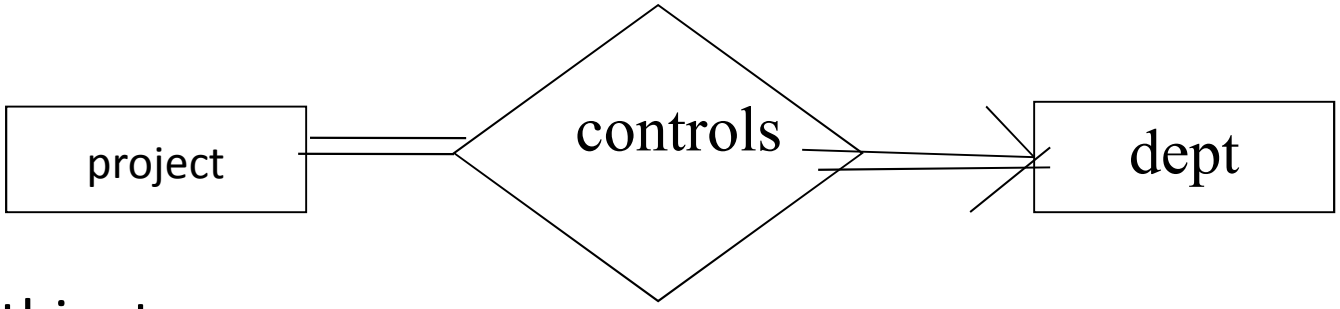
DEPARTMEMT (dnumber, name, mgrssn, mgrstartdate)

Step 5: Mapping of Binary 1:N Relationship Types.

Example: From previous step:

DEPARTMENT (dnumber, name, mgrssn, mgrstartdate)

PROJECT(pnumber, pname, plocation)

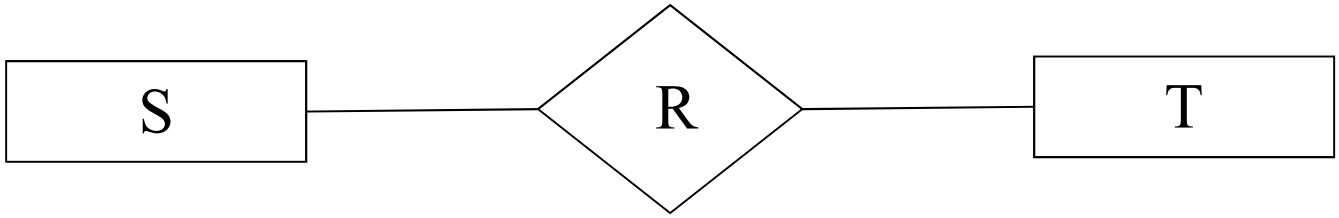


From this step:

DEPARTMENT (dnumber, name, mgrssn, mgrstartdate)

PROJECT(pnumber, pname, plocation, dno)

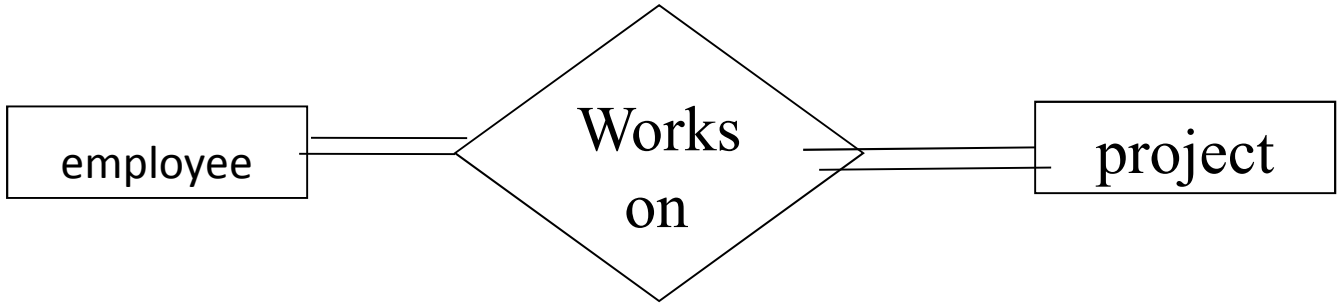
Step 6: Mapping of Binary M:N Relationship Types.



- 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 (or simple components of composite attributes) as attributes of S.

Step 6: Mapping of Binary M:N Relationship Types.

Example:Works on (essn, pno, hours)



Step 7: Mapping Multivalued attributes.

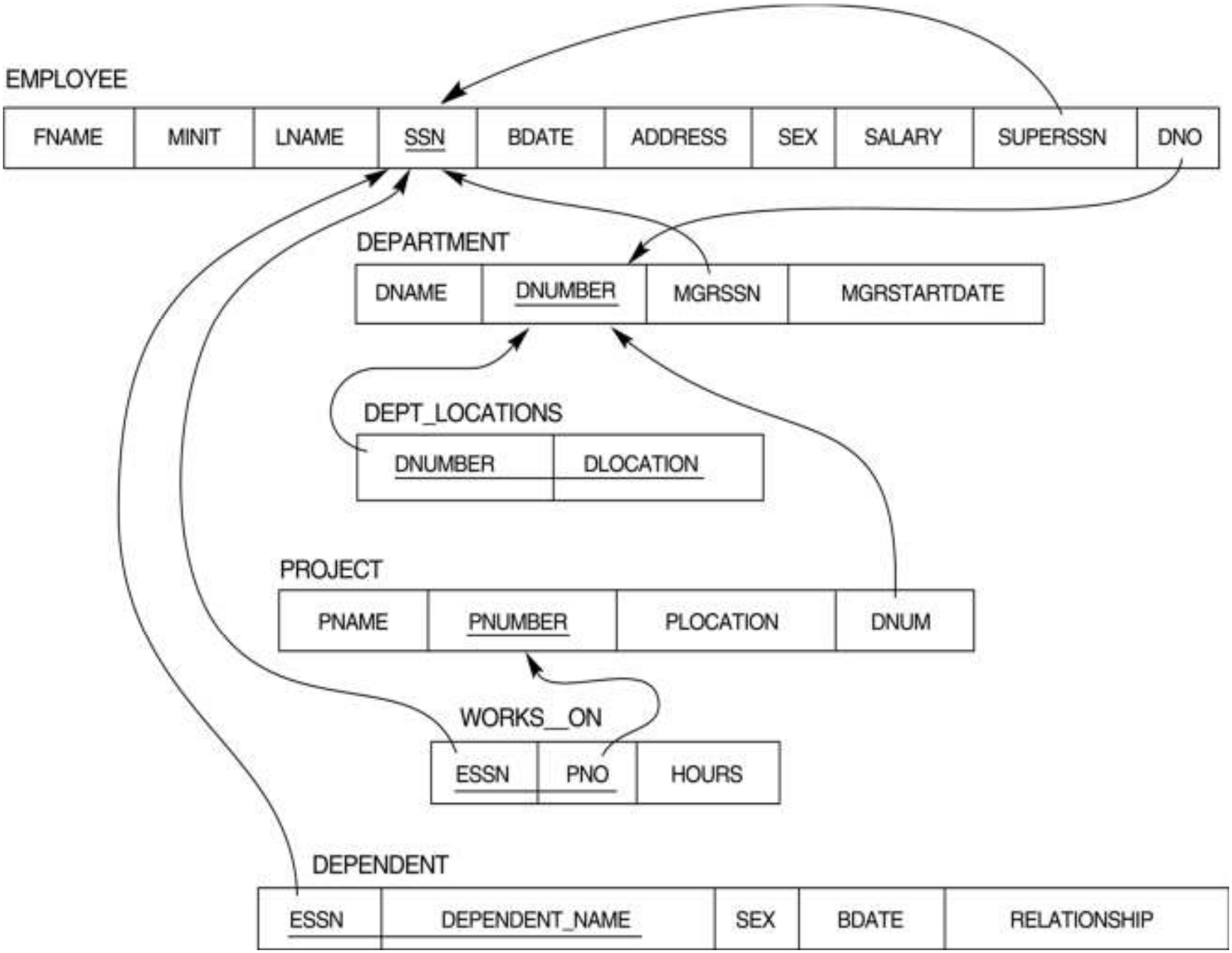
- For each multivalued attribute A, create a new relation R. This relation R will include an attribute corresponding to A, plus the primary key attribute K-as a foreign key in R-of the relation that represents the entity type of relationship type that has A as an attribute.
- The primary key of R is the combination of A and K. If the multivalued attribute is composite, we include its simple components.

Step 7: Mapping Multivalued attributes.

Example : DEPT_LOCATIONS (Dnumber, Dlocation)

where Dnumber is the foreign key referred to dnumber (primary key) of relation DEPARTMENT

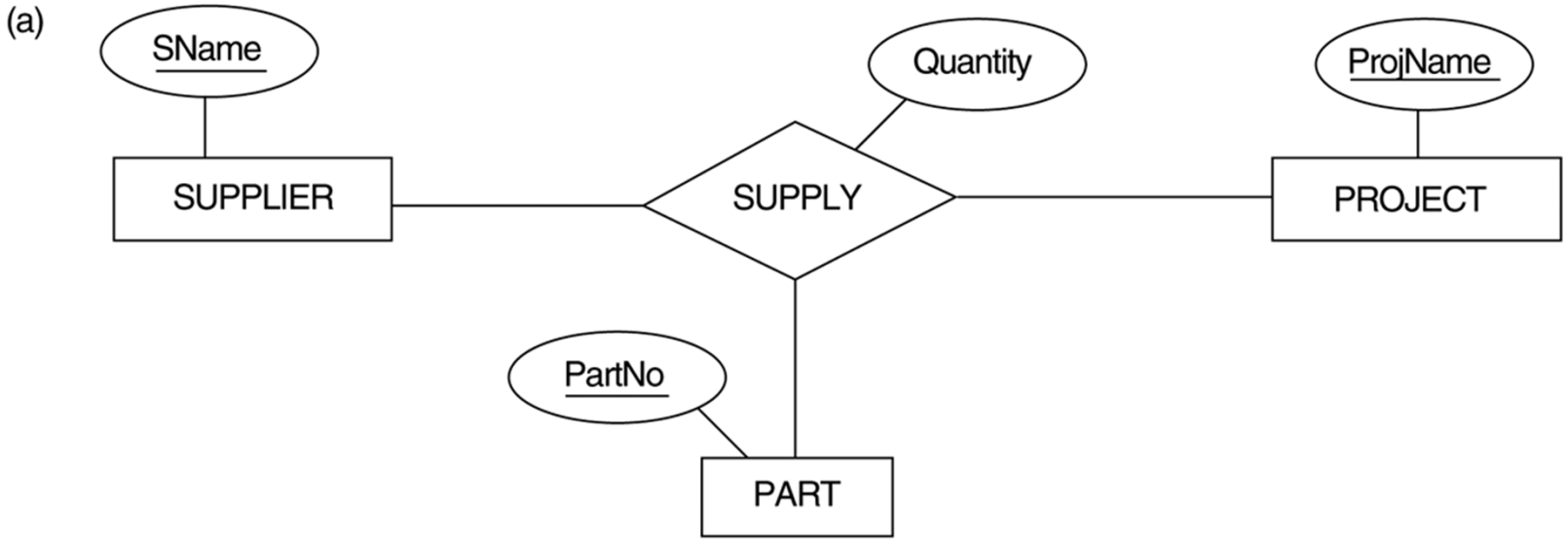
DEPARTMEMT (dnumber, name, mgrssn, mgrstartdate)


EMPLOYEE
FNAME
MINIT
LNAME
SSN
BDATE
ADDRESS
SEX
SALARY
SUPERSSN
DNO
DEPARTMENT
DNAME
DNUMBER
MGRSSN
MGRSTARTDATE
DEPT_LOCATIONS
DNUMBER
DLOCATION
PROJECT
PNAME
PNUMBER
PLOCATION
DNUM
WORKS_ON
ESSN
PNO
HOURS
DEPENDENT
ESSN
DEPENDENT_NAME
SEX
BDATE
RELATIONSHIP

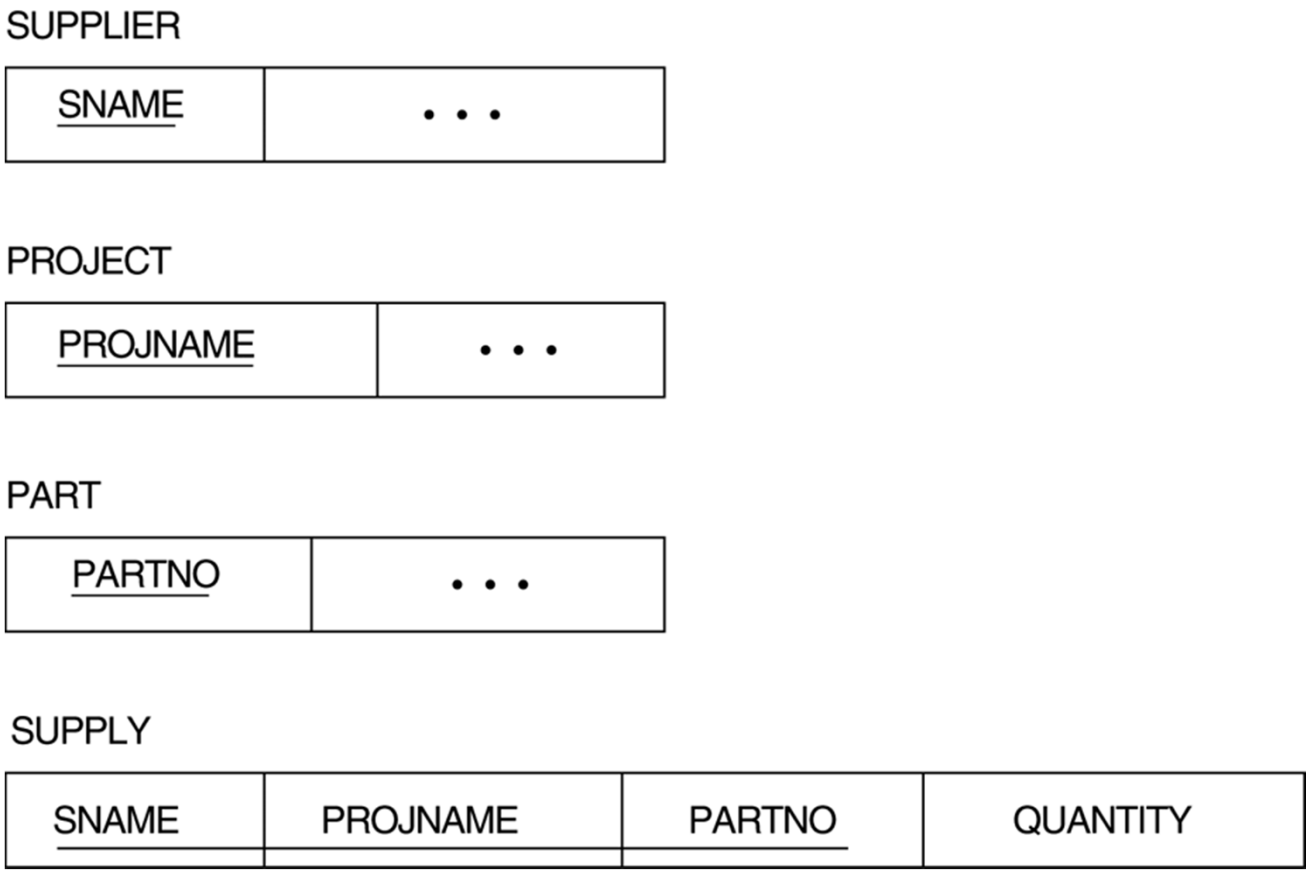
Step 8: Mapping of N-ary Relationship Types.

- For each n-ary relationship type R, where n>2, create a new relationship S to represent R.
- Include as foreign key attributes in S the primary keys of the relations that represent the participating entity types.
- Also include any simple attributes of the n-ary relationship type (or simple components of composite attributes) as attributes of S.

Ternary relationship SUPPLY



Mapping the *n*-ary relationship type SUPPLY



Mapping EER Model to Relational Model

Step9: Options for Mapping Specialization or Generalization.

Convert each specialization with m subclasses {S_1, S_2,….,S_m} and generalized superclass C, where the attributes of C are {$\underline{k}$,a_1,…a_n} and k is the (primary) key, into relational schemas using one of the four following options:

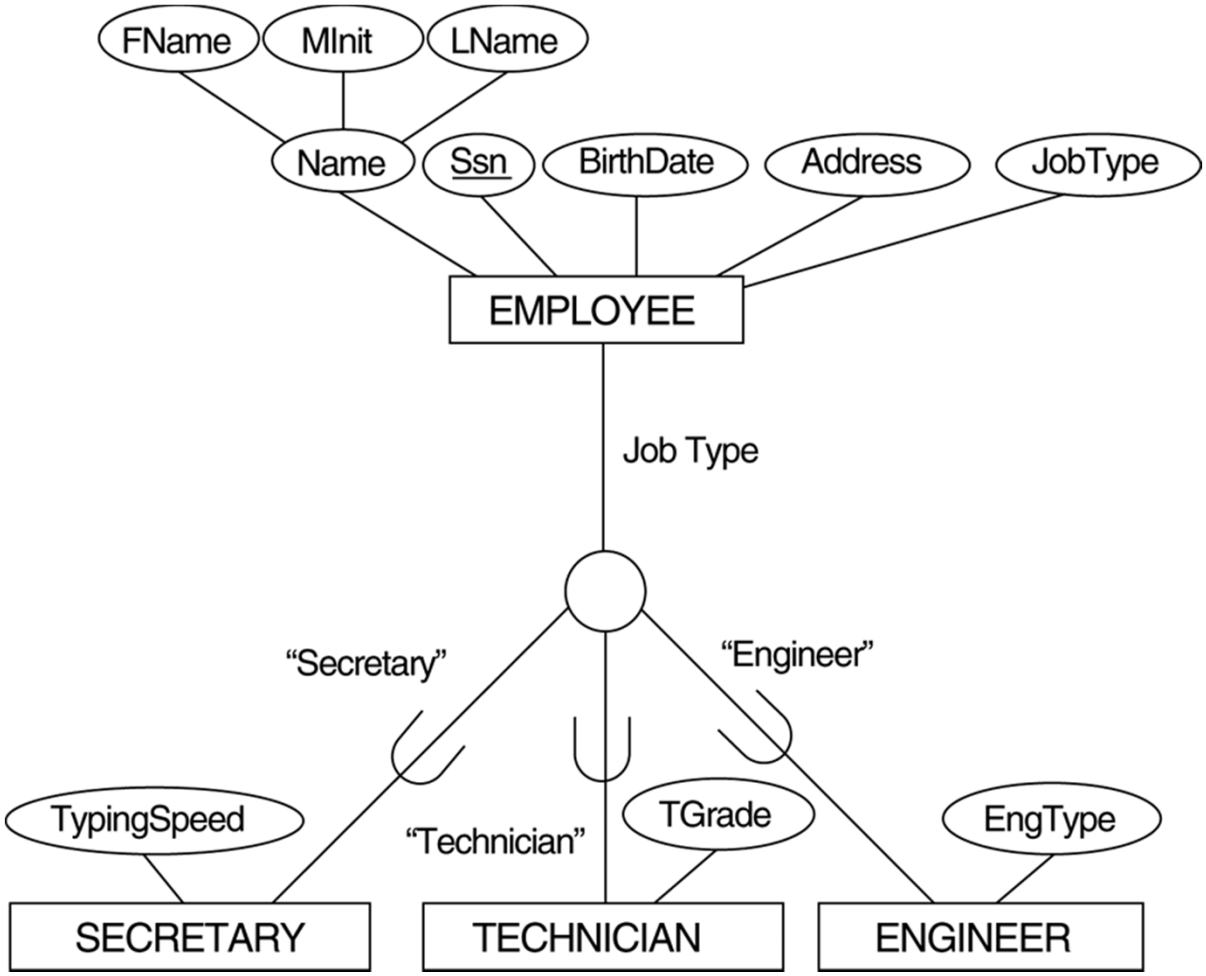
Option 9A: Multiple relations-Superclass and subclasses.

Option 9B: Multiple relations-Subclass relations only

Option 9C: Single relation with one type attribute.

Option 9D: Single relation with multiple type attributes.

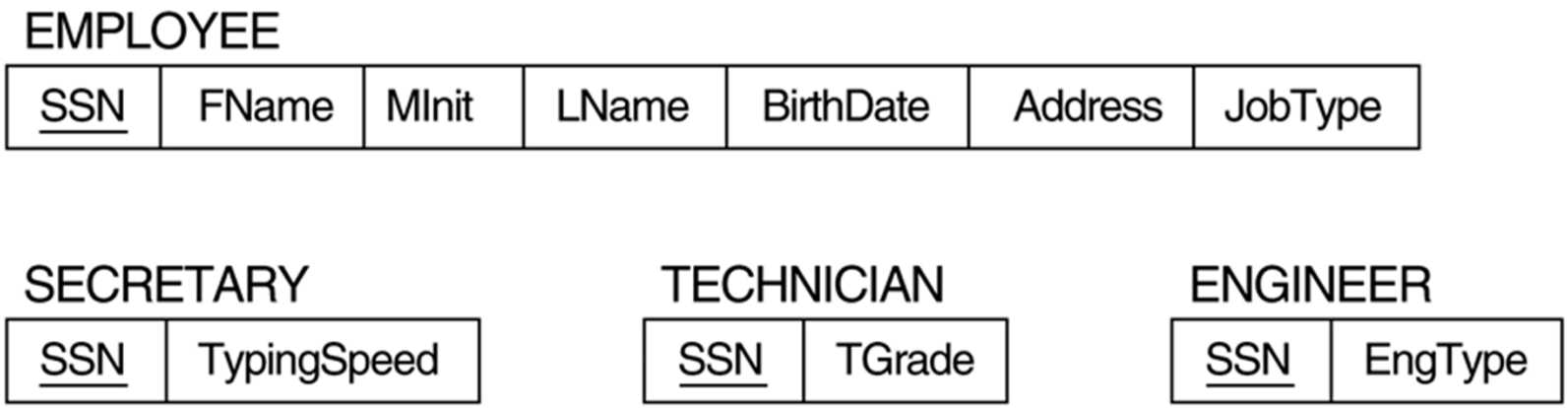
EER diagram notation for an attribute-defined specialization on JobType.



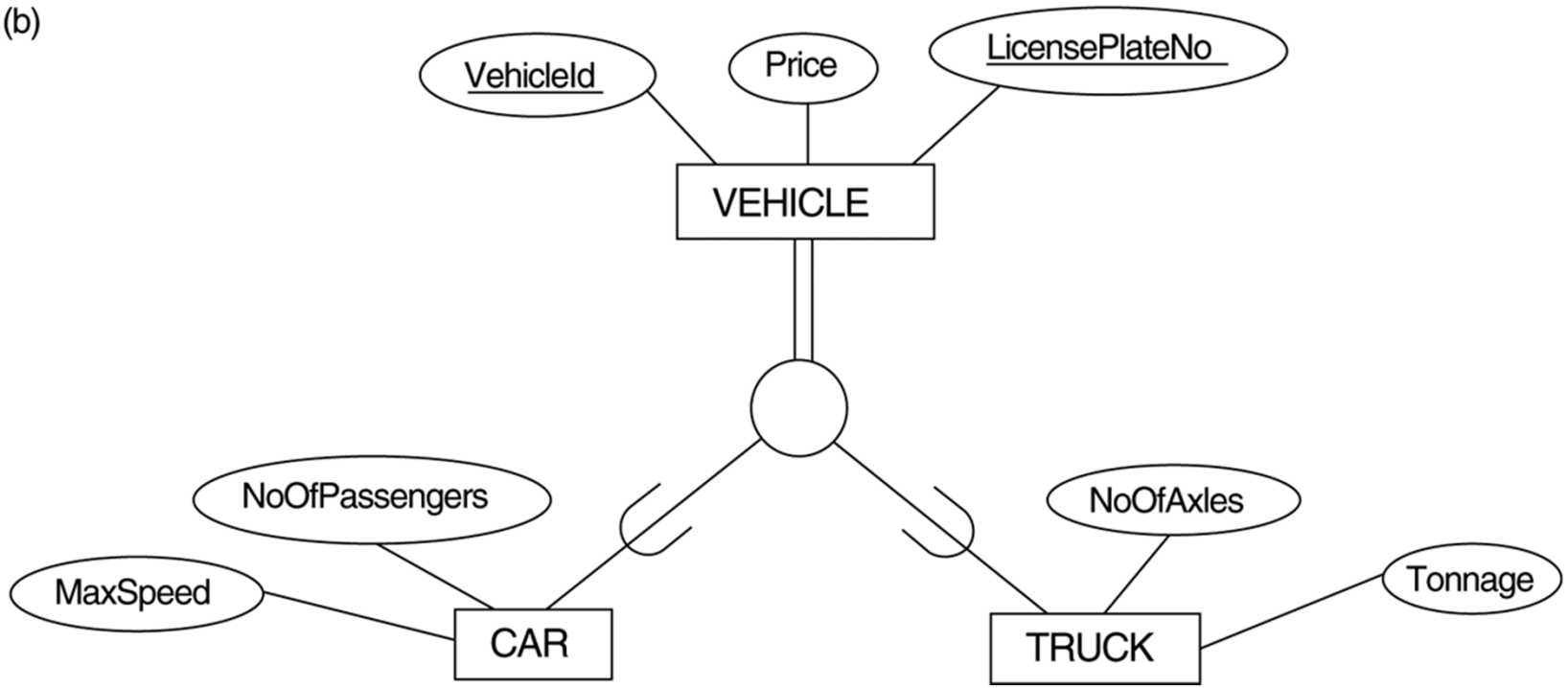
Mapping the EER schema in Figure using option 8A.

Multiple relations-Superclass and subclasses.

(a)



(b)


VehicleId
Price
LicensePlateNo
VEHICLE
NoOfPassengers
MaxSpeed
CAR
NoOfAxles
Tonnage
TRUCK

(b)

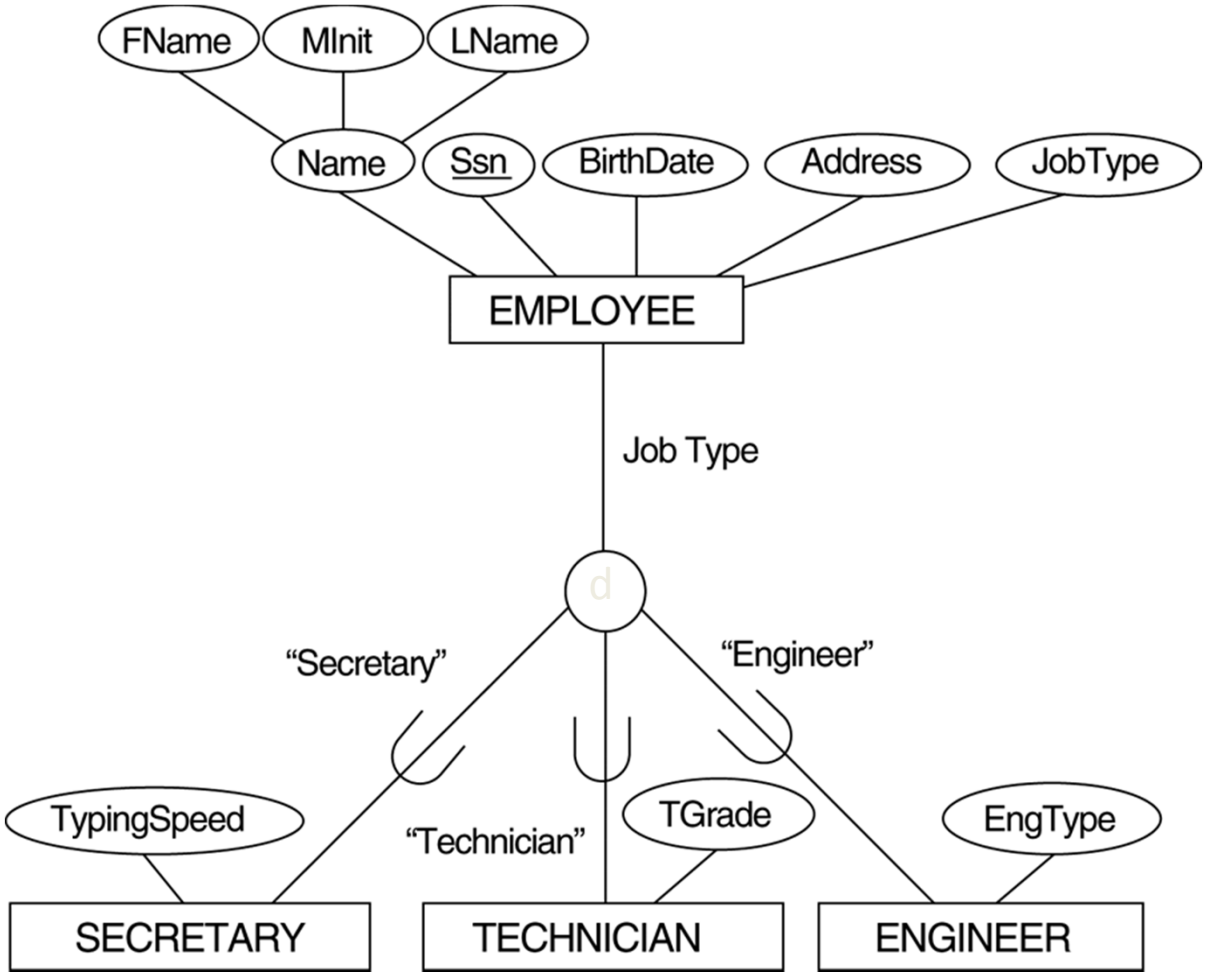
CAR

VehicleId	LicensePlateNo	Price	MaxSpeed	NoOfPassengers

TRUCK

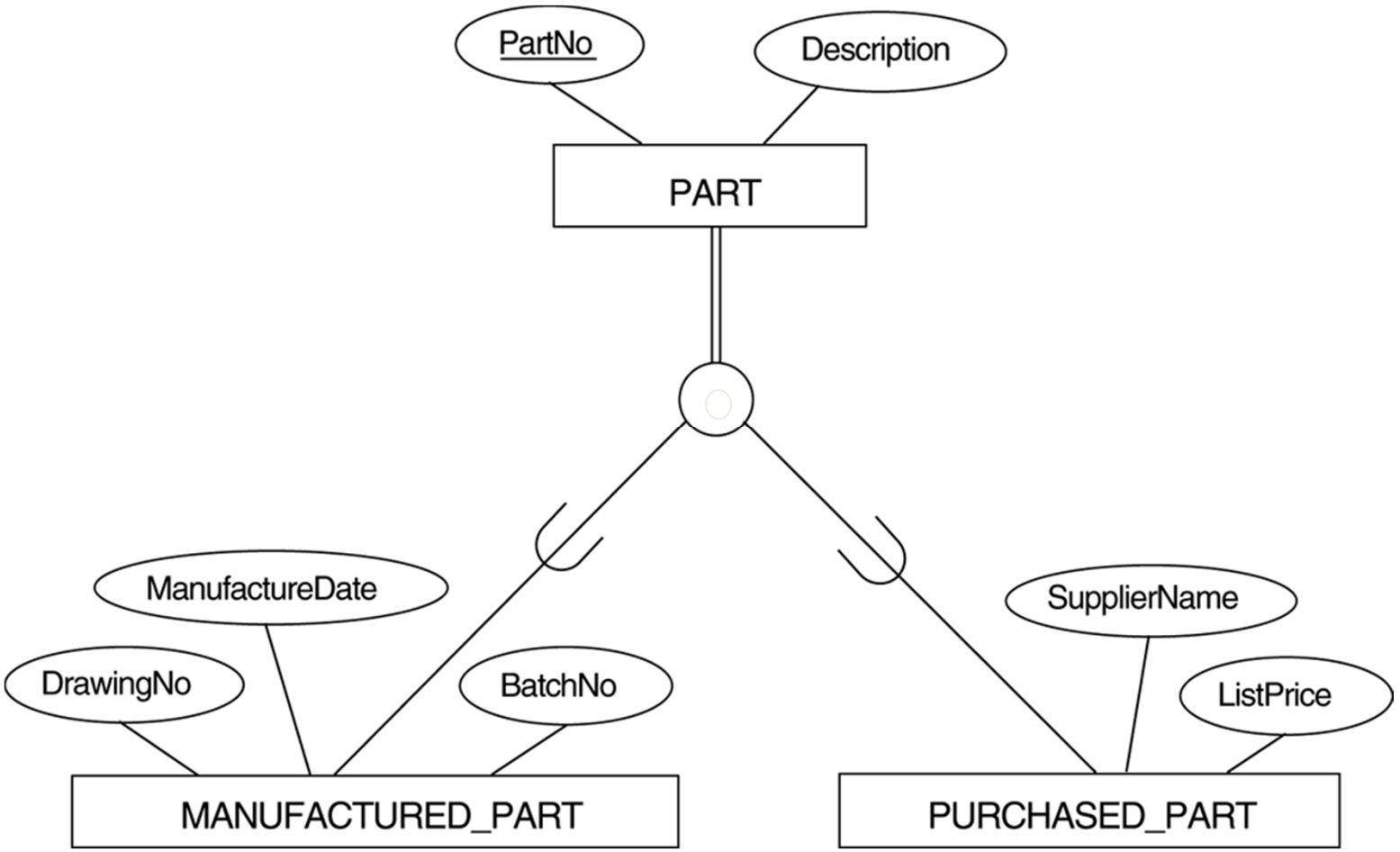
VehicleId	LicensePlateNo	Price	NoOfAxles	

EER diagram notation for an attribute-defined specialization on JobType.



(c) EMPLOYEE

SSN	FName	MInit	LName	BirthDate	Address	JobType	TypingSpeed	TGrade	


PartNo
Description
PART
ManufactureDate
DrawingNo
BatchNo
SupplierName
ListPrice
MANUFACTURED_PART
PURCHASED_PART

Eg. Mapping Figure using option 8D with Boolean type fields Mflag and Pflag.

(d) PART

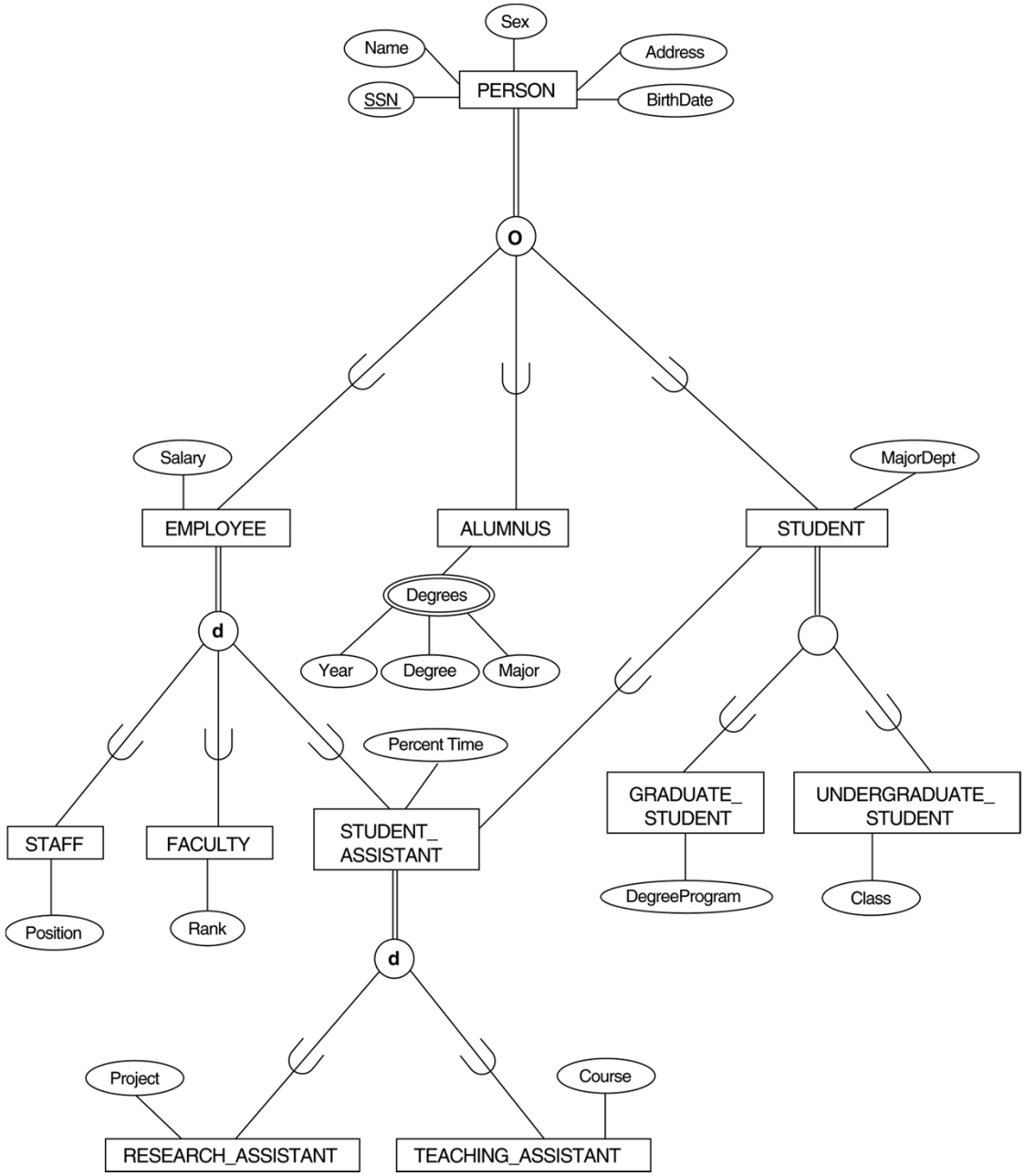
PartNo	Description	MFlag	DrawingNo	ManufactureDate	BatchNo	PFlag	SupplierName	ListPrice

Mapping of Shared Subclasses (Multiple Inheritance)

A shared subclass, such as STUDENT_ASSISTANT, is a subclass of several classes, indicating multiple inheritance. These classes must all have the same key attribute; otherwise, the shared subclass would be modeled as a category.

We can apply any of the options discussed in Step 9 to a shared subclass, subject to the restriction discussed in Step 9 of the mapping algorithm. Below both 9C and 9D are used for the shared class STUDENT_ASSISTANT.

A specialization lattice with multiple inheritance for a UNIVERSITY database.



Mapping the EER specialization lattice in Figure using multiple options.

PERSON

SSN	Name	BirthDate	Sex	Address

EMPLOYEE

SSN	Salary	EmployeeType	Position	Rank	PercentTime	RAFlag	TAFlag	Project	

ALUMNUS

SSN

ALUMNUS_DEGREES

SSN	Year	Degree	

STUDENT

SSN	MajorDept	GradFlag	UndergradFlag	DegreeProgram	Class	StudAssistFlag

Mapping ER-to-Relational Model

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Mapping EER-to-Relational Model

Step 9: Options for Mapping Specialization or Generalization.

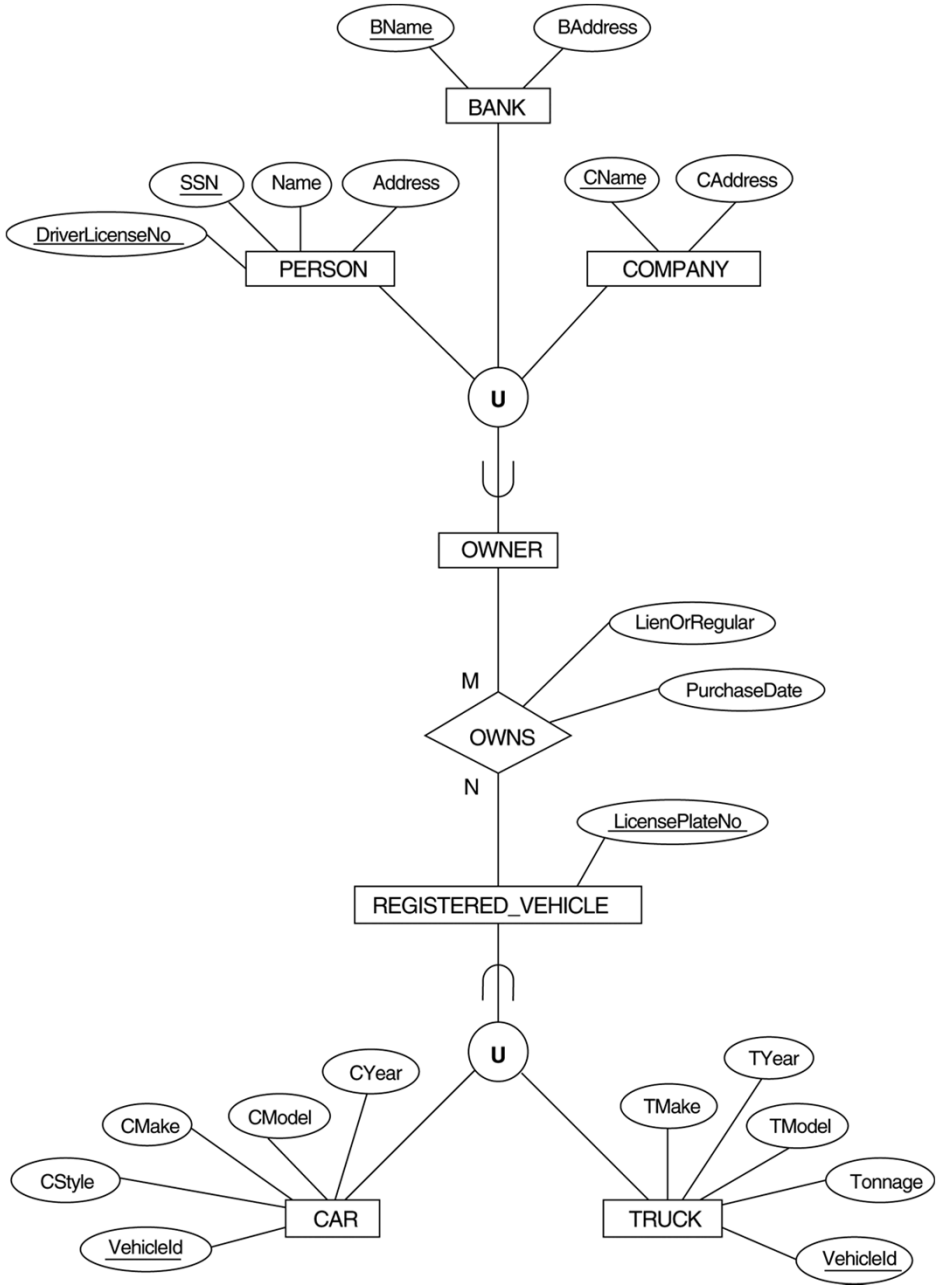
Step 10: Mapping of Union Types (Categories).

Step 10: Mapping of Union Types (Categories).

- For mapping a category whose defining superclass have different keys, it is customary to specify a new key attribute, called a **surrogate key**, when creating a relation to correspond to the category.

- In the example below we can create a relation OWNER to correspond to the OWNER category and include any attributes of the category in this relation. The primary key of the OWNER relation is the surrogate key, which we called OwnerId.

Two categories (union types): OWNER and REGISTERED_VEHICLE.



Mapping the EER categories (union types) to relations.

PERSON

SSN	DriverLicenseNo	Name	Address	OwnerId

BANK

BName	BAddress	OwnerId

COMPANY

CName	CAddress	OwnerId

OWNER

OwnerId

REGISTERED_VEHICLE

VehicleId	LicensePlateNumber

CAR

VehicleId	CStyle	CMake	CModel	

TRUCK

VehicleId	TMake	TModel	Tonnage	TYear

OWNS

OwnerId	VehicleId	PurchaseDate	LienOrRegular