DATABASE ANALYSIS AND DESIGN 6

Week 7

ER and EER to Relational Mapping

7-Step Process:

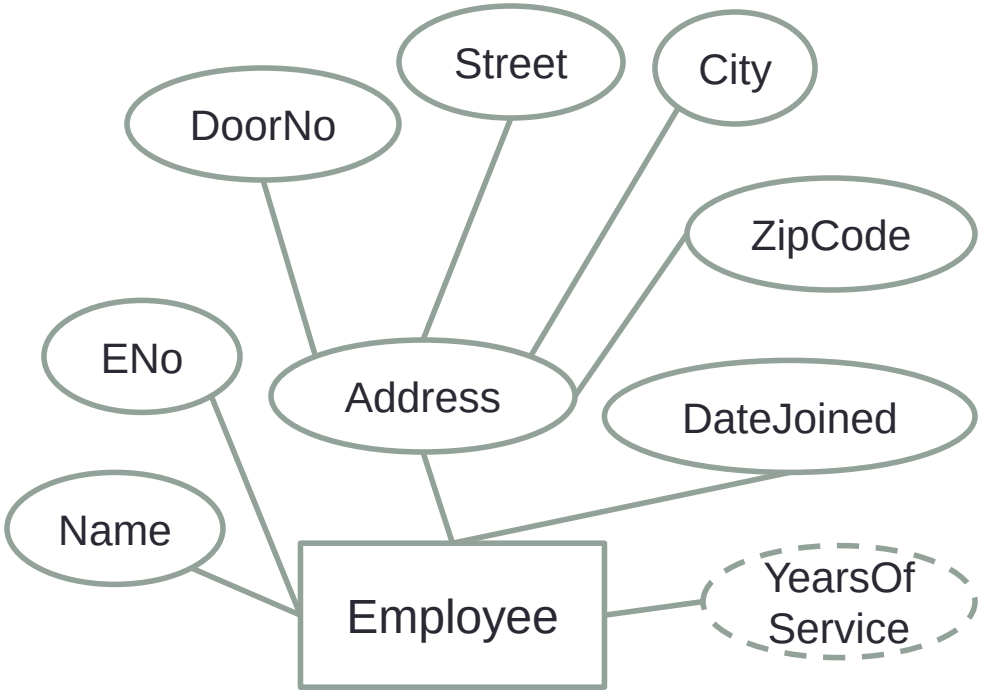
1. Map **Regular Entity** Types
2. Map **Weak Entity** Types
3. Map **Binary 1:1 Relation** Types
4. Map **Binary 1:N Relationship** Types.
5. Map **Binary M:N Relationship** Types.
6. Map **Multivalued attributes**.
7. Map **N-ary Relationship** Types.

Step 1: Mapping of Regular (Strong) Entity Types

- Each **entity type** becomes a **table**
- Each **single-valued attribute** becomes a **column**
- **Derived attributes** are **ignored**
- **Composite attributes** are represented by **components**
- The **key attribute** of the entity type becomes the **primary key** of the table

Entity Example

- Here address is a composite attribute
- Years of service is a derived attribute (can be calculated from date of joining and current date)



- **The relational Schema**

Employee (ENo, Name, DoorNo, Street, City, ZipCode, DateJoined)

Entity Example

Employee (ENo, Name, DoorNo, Street, City, ZipCode, DateJoined)

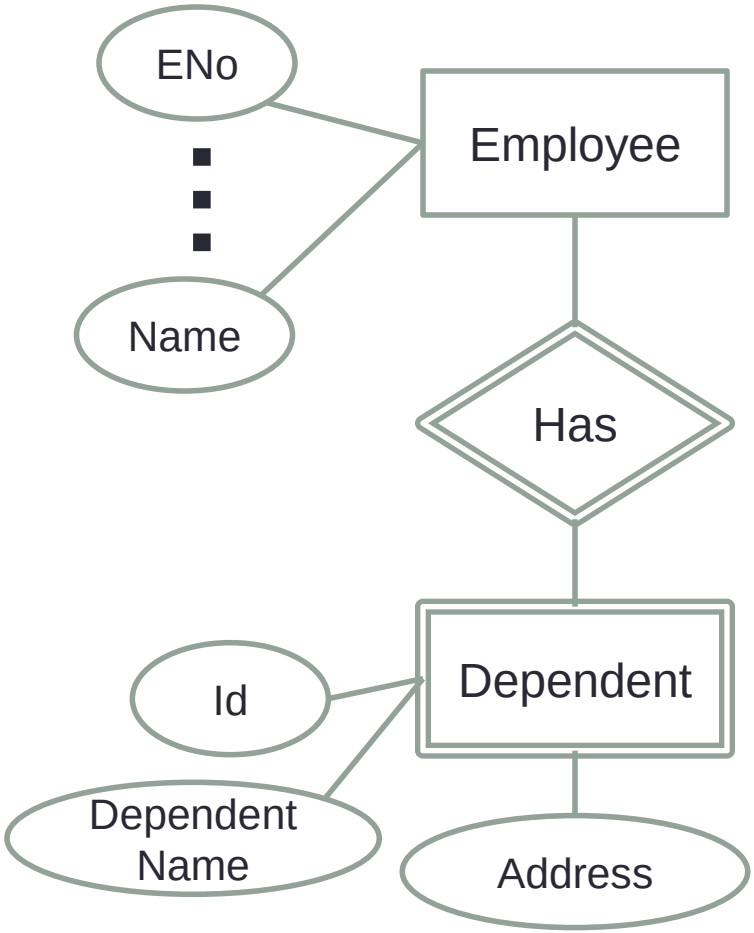
Employee
ENo PK
Name
DoorNo
Street
City
ZipCode
DateJoined

Step 2: Mapping of Weak Entity Types

- Weak entity types are converted into a table of their own, with the primary key of the strong entity acting as a foreign key in the table

- This foreign key along with the key of the weak entity form the composite primary key of this table

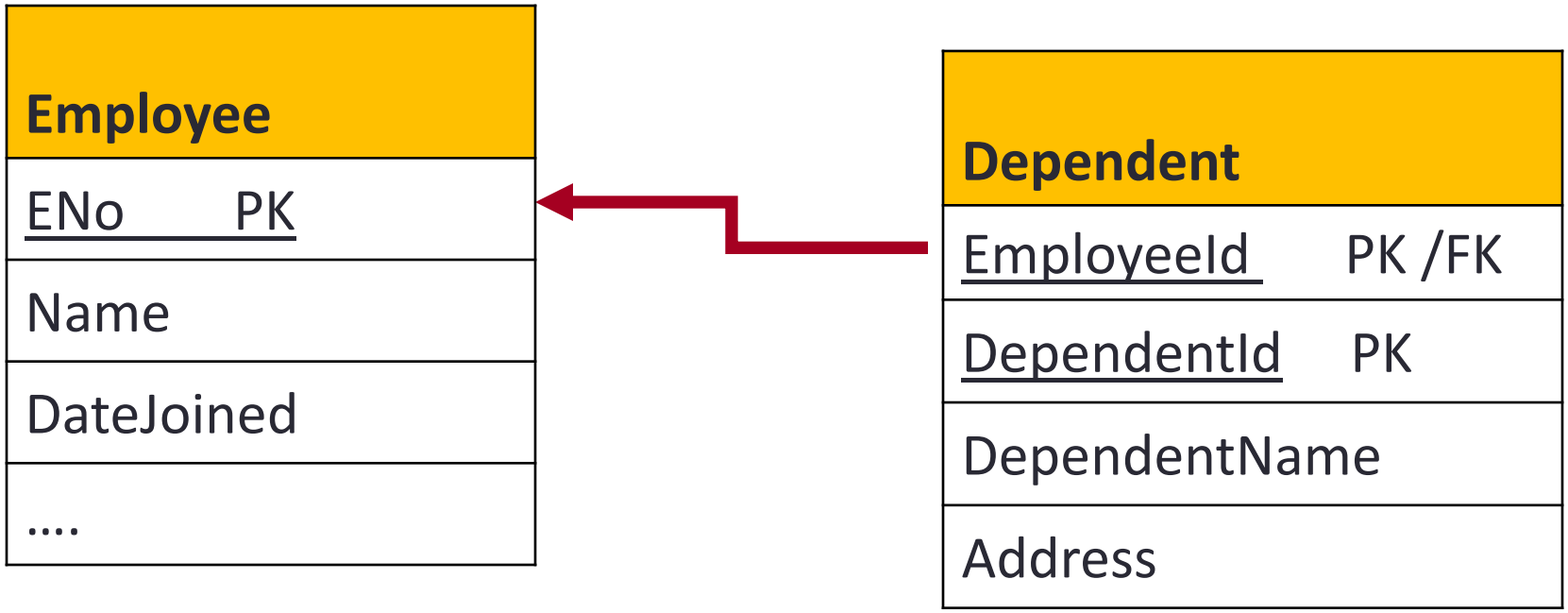
- **The Relational Schema**



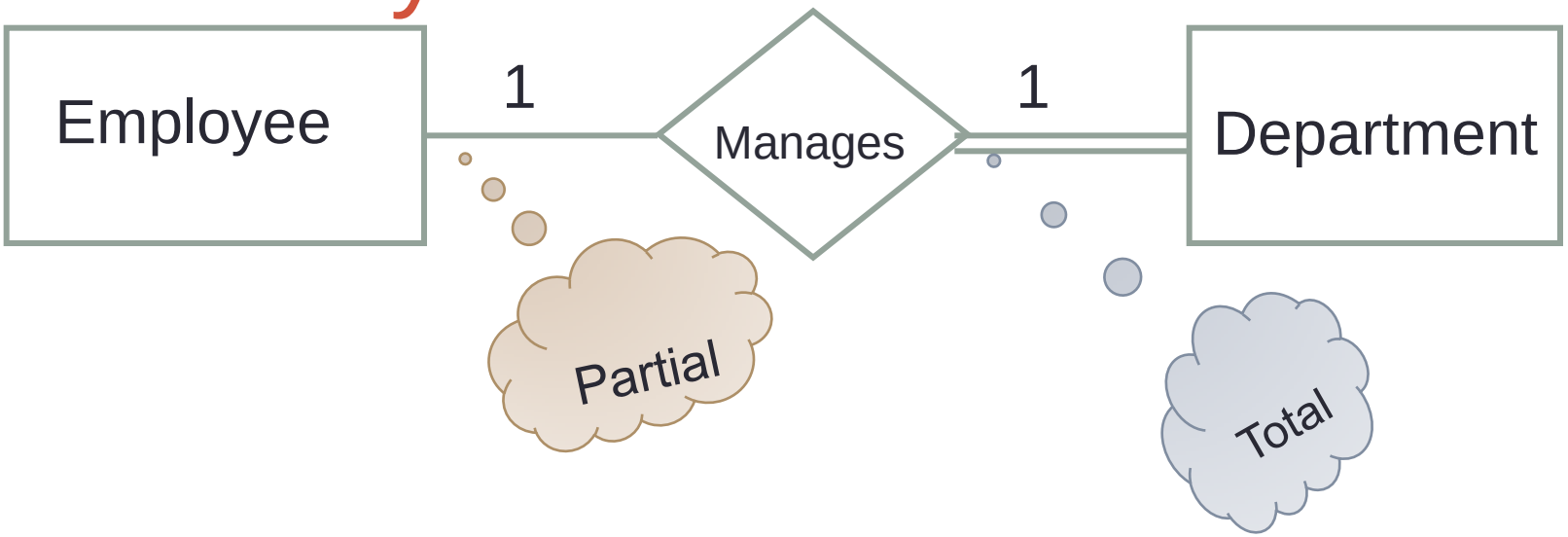
Employee (ENo ,…….)

Dependant (EmployeeId, DependantId, DependentName, Address)

Mapping of Weak Entity Types (Cont'd)



Step 3: Binary 1:1



- **Case 1:** Combination of participation types

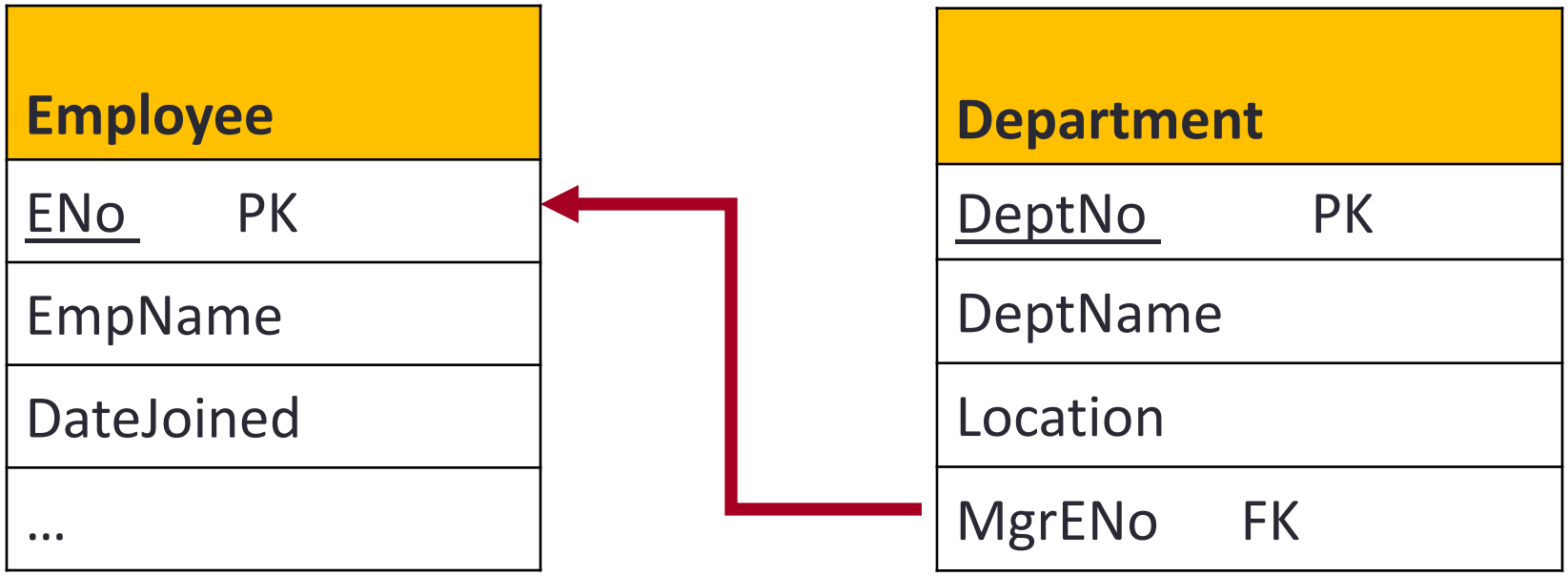
The primary key of the partial participant will become the foreign key of the total participant

Employee(ENo, Name,…)

Department (DeptNo, DeptName…, MgrENo)

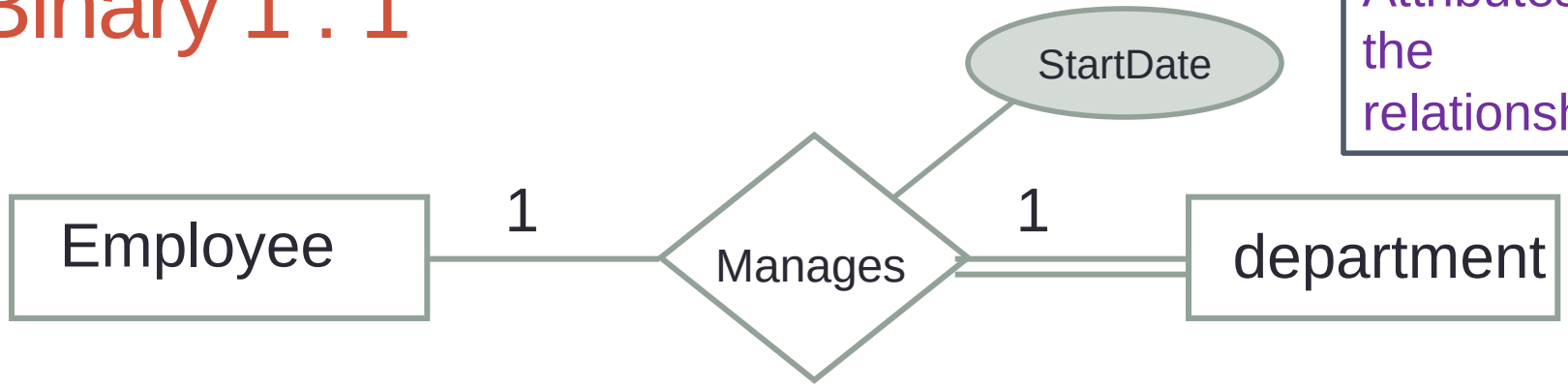
IF PK of total participant is used as the FK in partial participant, it will have null value for employee tuples who do not manage a department.

Binary 1 : 1


Employee
ENo PK
EmpName
DateJoined
…
Department
DeptNo PK
DeptName
Location
MgrENo FK

Binary 1 : 1

Attributes of the relationship



Employee	
ENo	PK
EmpName	
DateJoined	
…	

Department	
DeptNo	PK
DeptName	
Location	
MgrStartDate	
MgrENo	FK

Binary 1:1

- **Case 2:** Uniform participation types

The primary key of either of the participants can become a foreign key in the other.

Employee (ENo, Name…)

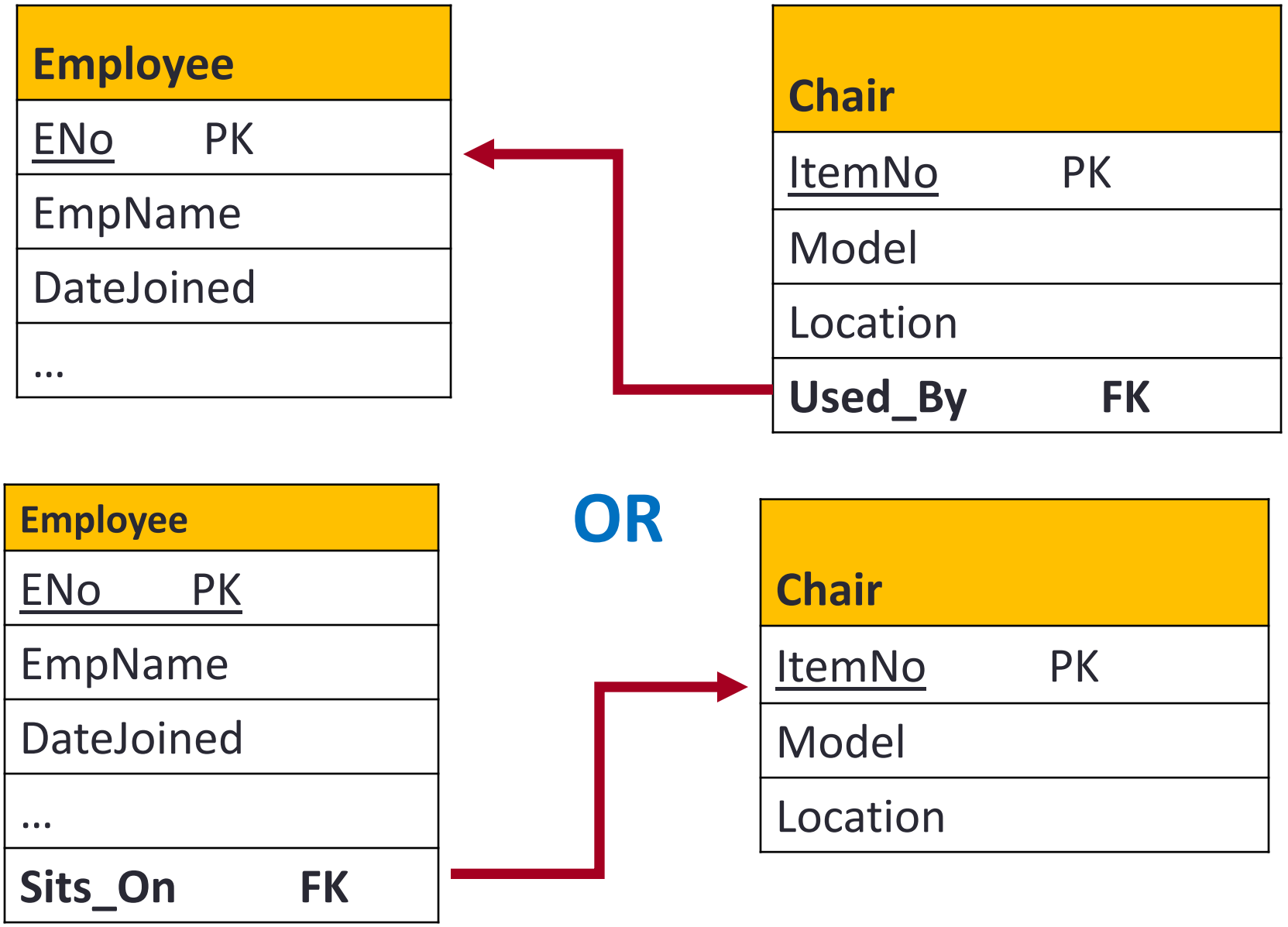
Chair(ItemNo, Model, Location, **Used_by**)

(or)

Employee (ENo, Name….**Sits_on**)

Chair (ItemNo,….)

Binary 1:1


Employee
ENo PK
EmpName
DateJoined
...
Chair
ItemNo PK
Model
Location
Used_By FK
OR
Employee
ENo PK
EmpName
DateJoined
...
Sits_On FK
Chair
ItemNo PK
Model
Location

Binary 1:1

- Case 1 and 2 are known as foreign key approach.

- **Case 3:** If both participations are total, "merge relation option" could be used. That is, Merging the two entity types and the relationship into a single relation.
  - If not, case 2 could be used.

Employee
ENo PK
EmpName
DateJoined
ItemNo
Model
Location

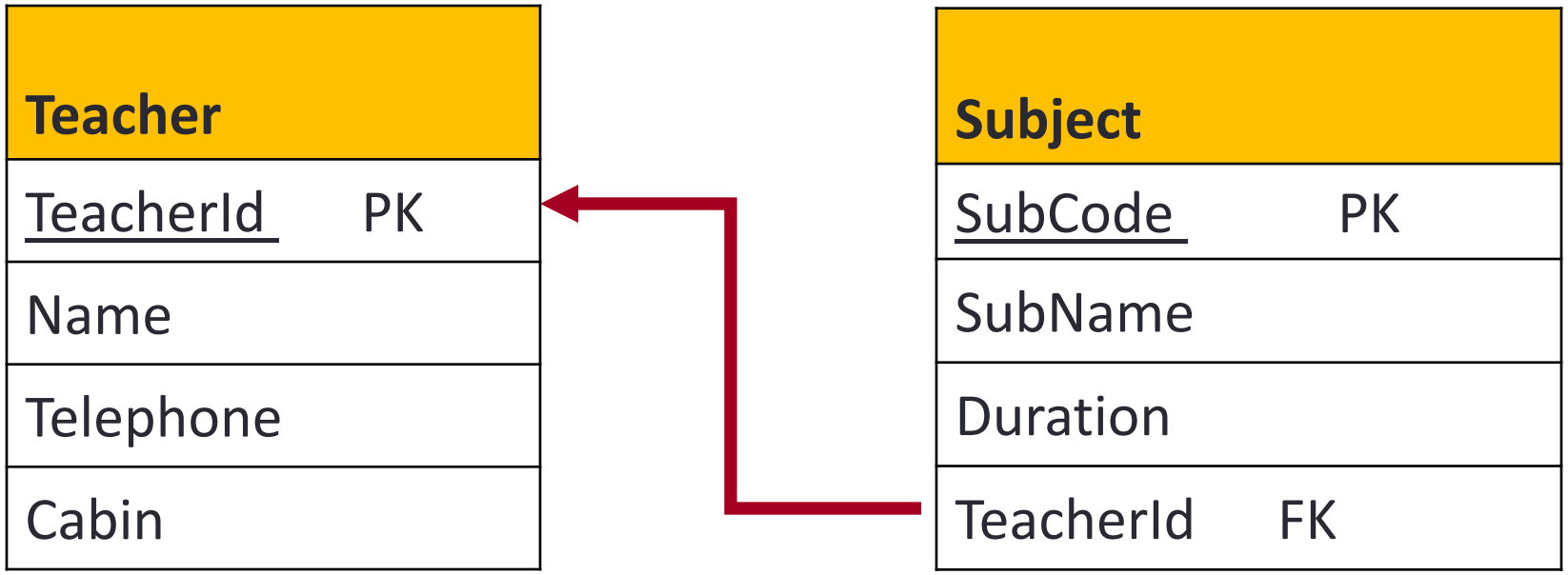
Step 4: Binary 1:N

The primary key of the relation on the "1" side of the relationship becomes a foreign key in the relation on the "N" side.

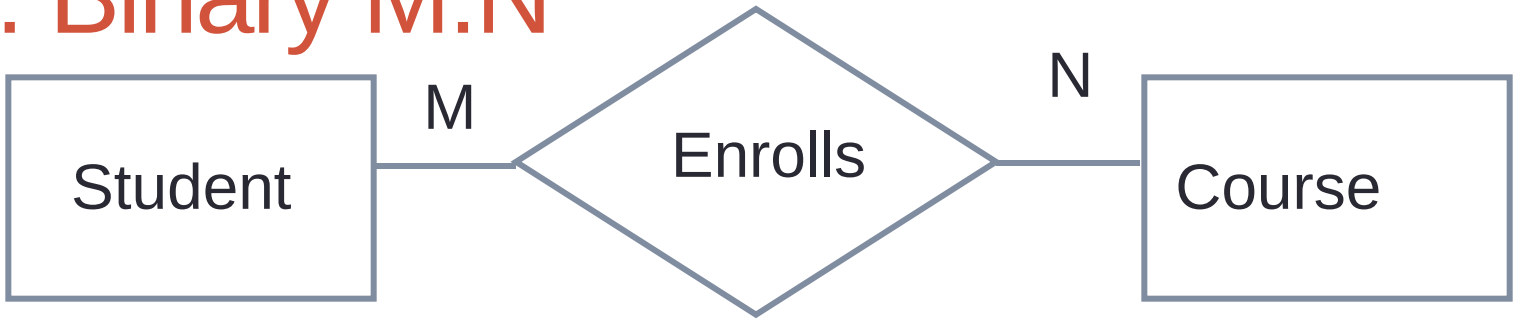
Teacher (TeacherId, Name, Telephone, ...)

Subject (Code, Name, ..., TeacherId)

Binary 1:N


Teacher
TeacherId PK
Name
Telephone
Cabin
Subject
SubCode PK
SubName
Duration
TeacherId FK

Step 5: Binary M:N



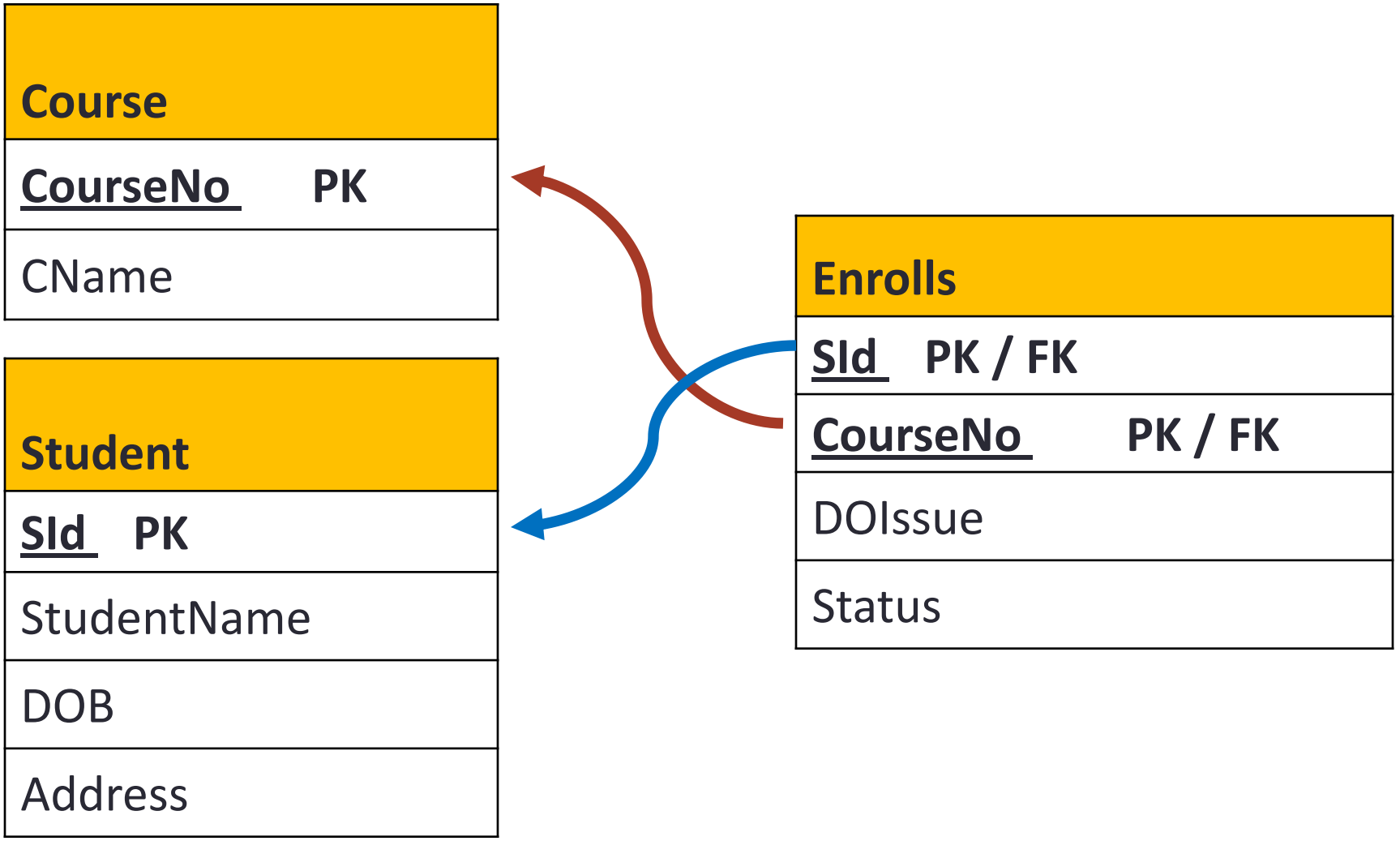
- A new table is created to represent the relationship
- It will be a lookup table
- It contains two foreign keys - one from each of the participants in the relationship
- The primary key of the new table is the combination of the two foreign keys

Student (SId, Title…)

Course(CourseNo, CName,…)

Enrolls (SId, CourseNo)

Binary M:N


Course
CourseNo PK
CName
Student
SId PK
StudentName
DOB
Address
Enrolls
SId PK / FK
CourseNo PK / FK
DOIssue
Status

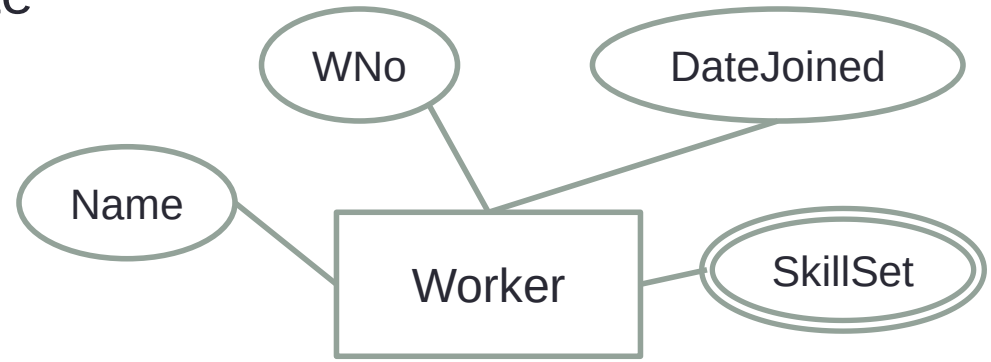
Step 6- Mapping Multivalued Attributes

- For each multivalued attribute create a new relation

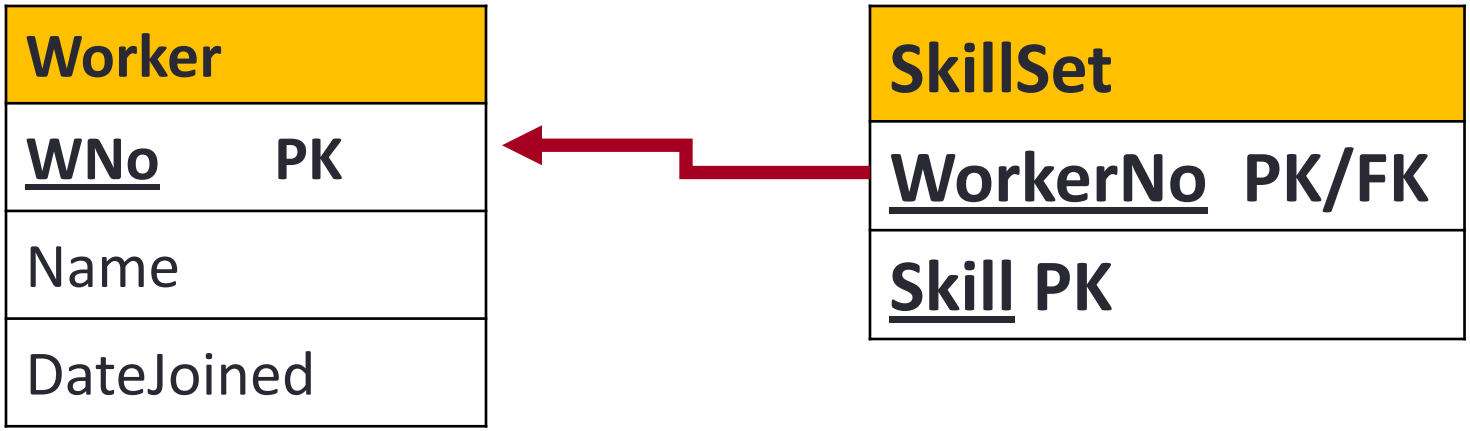
- **The Relational Schema**

Worker(WNo, Name, DateJoined)

SkillSet(WorkerNo, Skill)

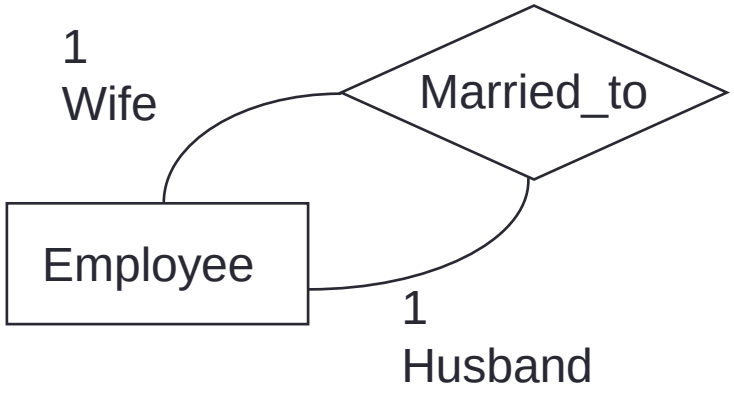


Entity Example



Step 7- Mapping Degree of Relationship

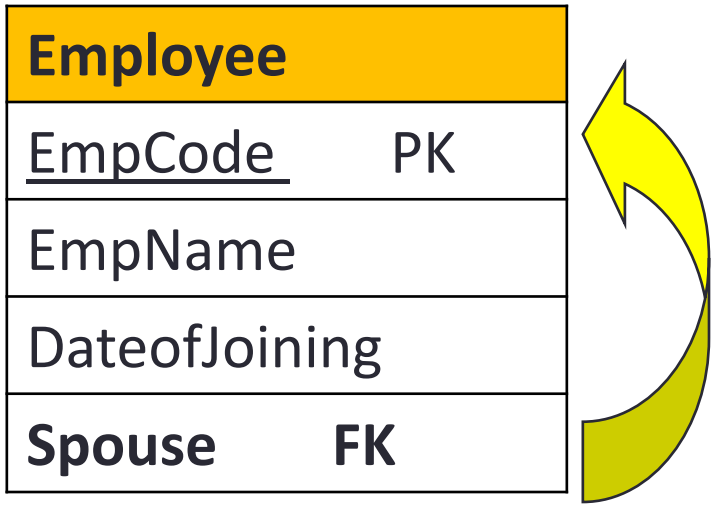
Self referencing 1:1



- Consider employees who are also a couple

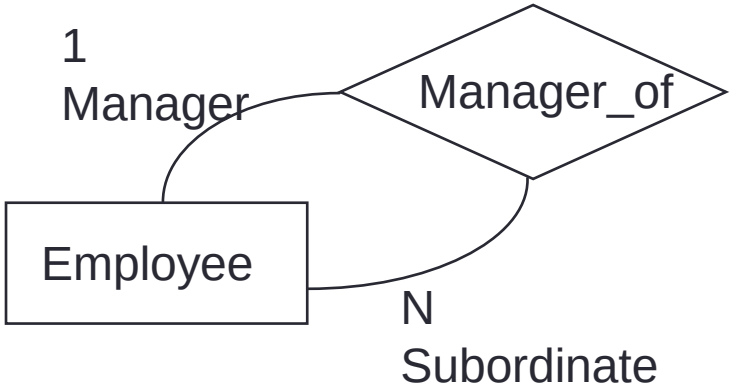
- The primary key field itself will become foreign key in the same table

Employee(ENo, Name,... Spouse)

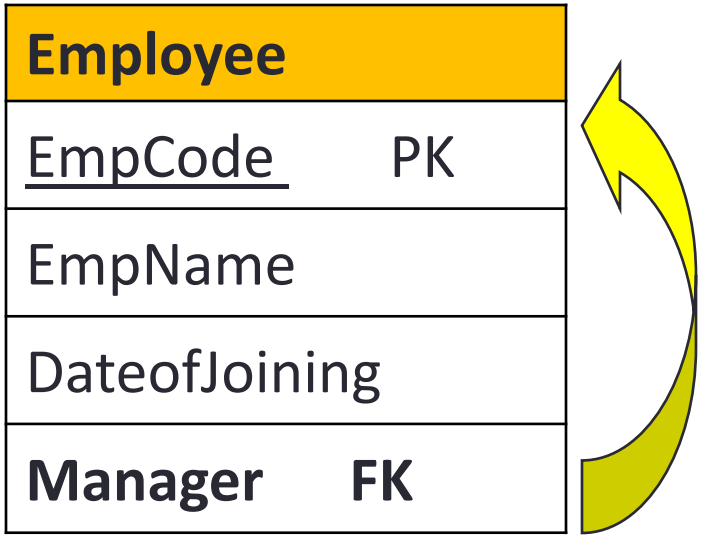


Self referencing 1:N

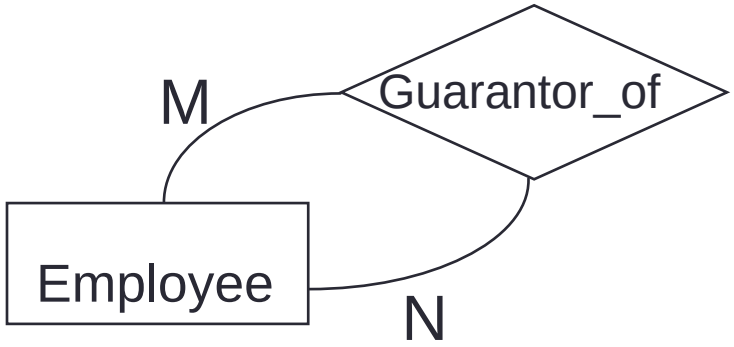
- The primary key field itself will become foreign key in the same table
- Same as unary 1:1



Employee(ENo, Name, …, Manager)



Self referencing M:N



- There will be two resulting tables.
- One to represent the entity and another to represent the M:N relationship as follows

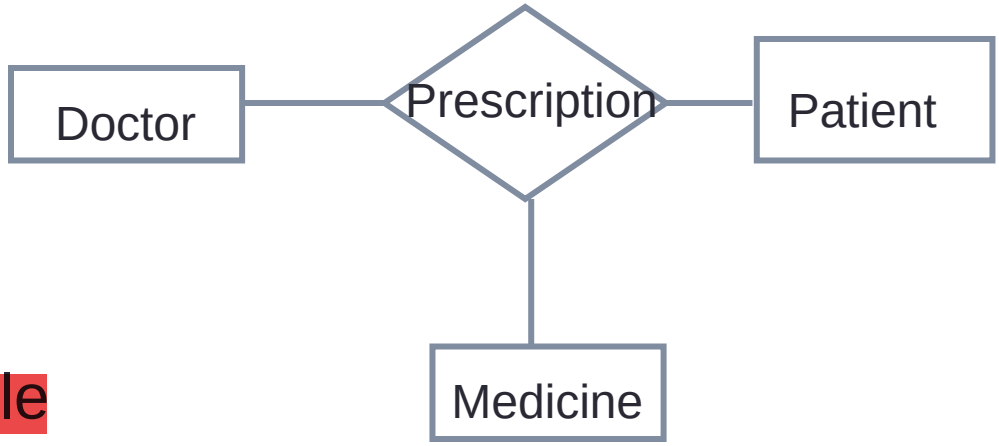
Employee(ENo, Name,…)

Guaranty(Guarantor, beneficiary)

Employee	
EmpCode	PK
EmpName	
DateofJoining	

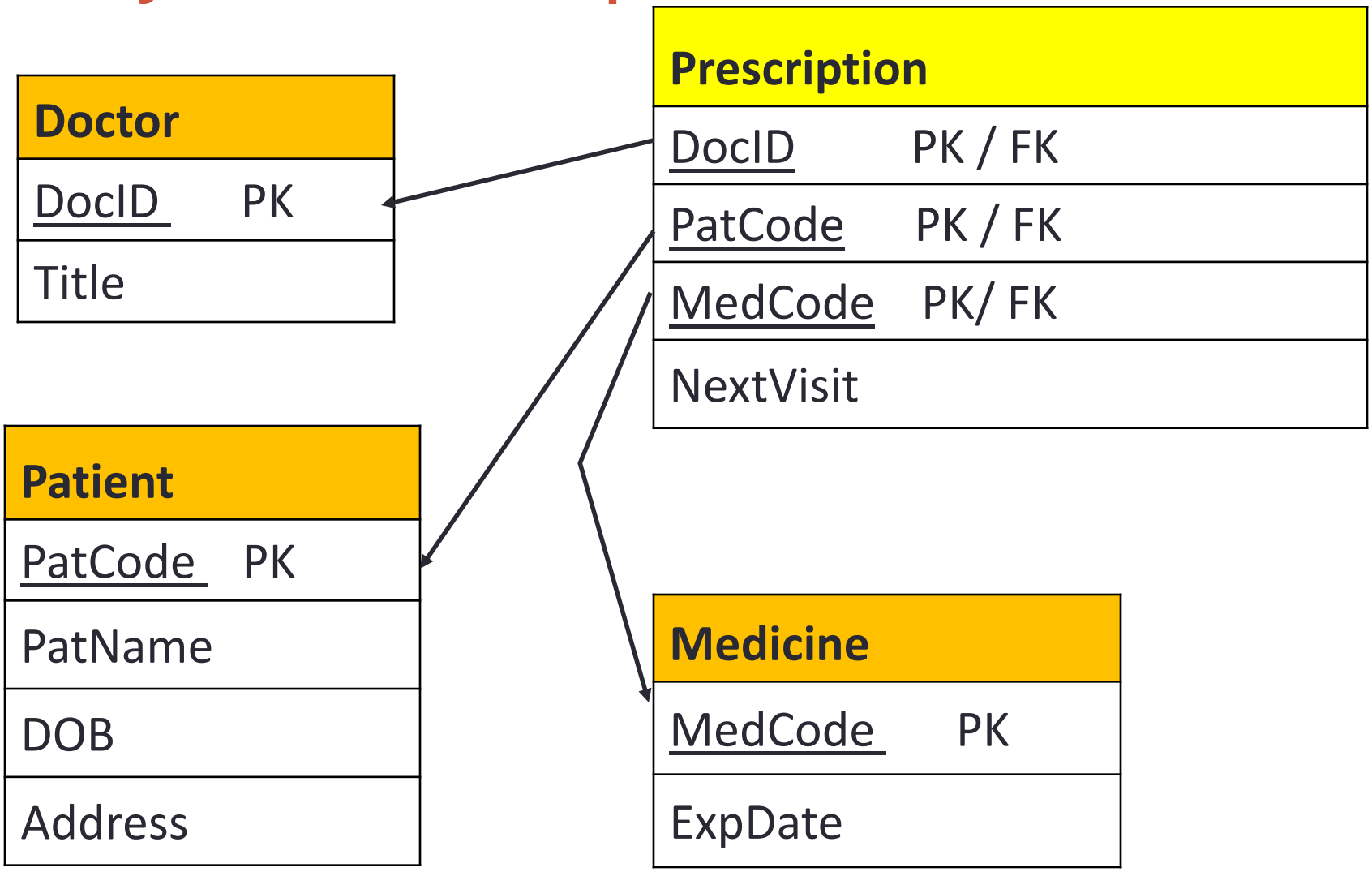
Guaranty	
Guarantor	PK/FK
Beneficiary	PK /FK

Ternary relationship



- Represented by a new table
- The new table contains three foreign keys - one from each of the participating Entities
- The primary key of the new table is the combination of all three foreign keys
- Prescription (DoctorNo, PatientNo, MedicineCode)

Ternary Relationship



Summary

ER Model	Relational Model
1:1 or 1:N relationship type	Foreign key
M:N Relationship type	‘Relationship’ relation and 2 foreign keys
N-ary relationship type	‘Relationship’ relation and a foreign key
Simple attribute	Attribute
Composite attribute	Set of simple component attribute
Multivalued attribute	Relation and foreign key
Key attribute	Primary key

EER To Relational Model

Step 8: EER Specialization/Generalization

- For Superclass/Subclass Relationships in 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 $\{k, a_1, \ldots, a_n\}$ and *k* is the (primary) key, into relation schemas using one of the four following options

1. Option 8A: Multiple relations - superclass and subclass
2. Option 8B: Multiple relations - subclass only
3. Option 8C: Single relation with one type attribute
4. Option 8D: Single relation with multiple type attributes

Multiple relation option

Single relation option

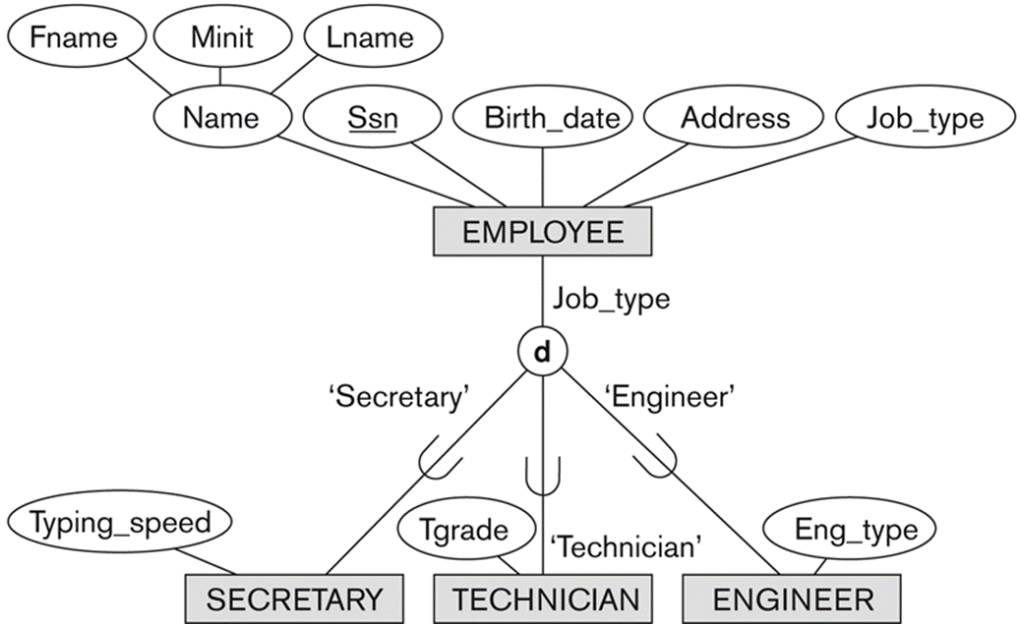
Options A (Multiple relation)

Option 8A:

- Create a relation L for C with attributes $Attrs(L)=\{k,a_1,\ldots,a_n\}$ and $PK(L)=k$.

- Create a relation L_i for each subclass S_i, $1 <= i <= m$, with the attributes $Attrs(L_i) = \{k\} \cup \{attributes\ of\ S_i\}$ and $PK(L_i)=k$.

This works for **any specialization** (total or partial, disjoint or overlapping).



(a) Employee

Option 8A

SSN	FName	Minit	LName	BOD	Address	JobType

Secretary

SSN	TypingSpeed

Technician

SSN	TGrade

Engineer

SSN	EngType

Options B (Multiple relation)

Option 8B:

- Create a relation L_i for each subclass S_i,

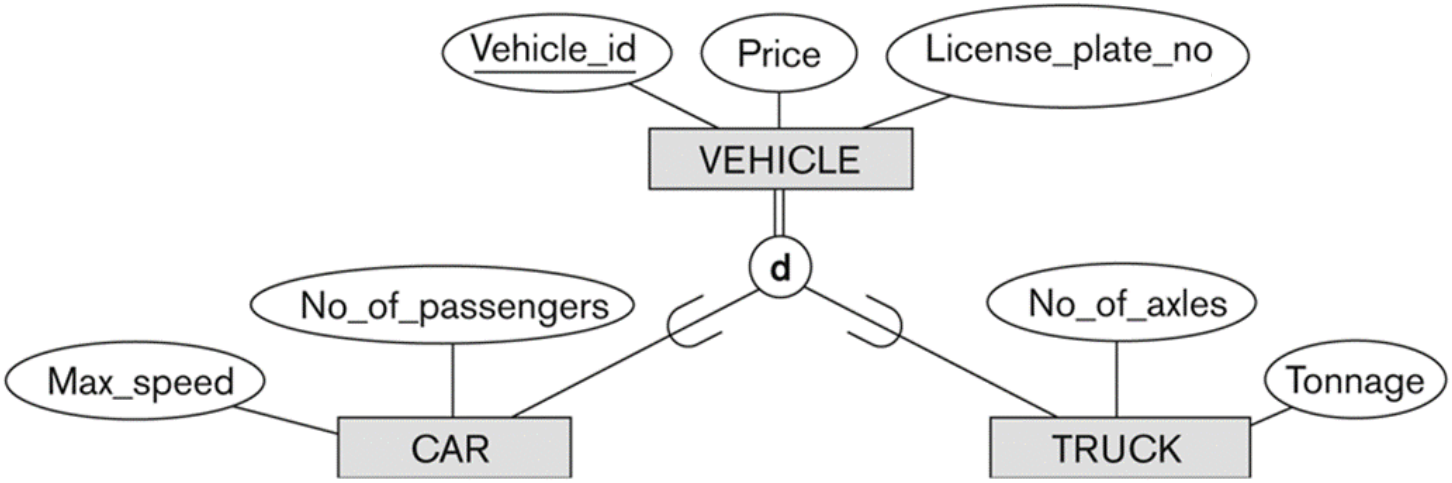
1 <= *i* <= *m*, with the attributes

Attrs(L_i) = {k ,a_1,…,a_n} U {attributes of S_i} and PK(L_i)=k.

This works only for a specialization whose subclasses are **total**.

Example

Option 8B



(b) Car

Vehicle_Id	License_plate_no	Price	Max_speed	No_of_Passengers

Truck

Vehicle_Id	License_plate_no	Price	No_of_axles	Tonnage

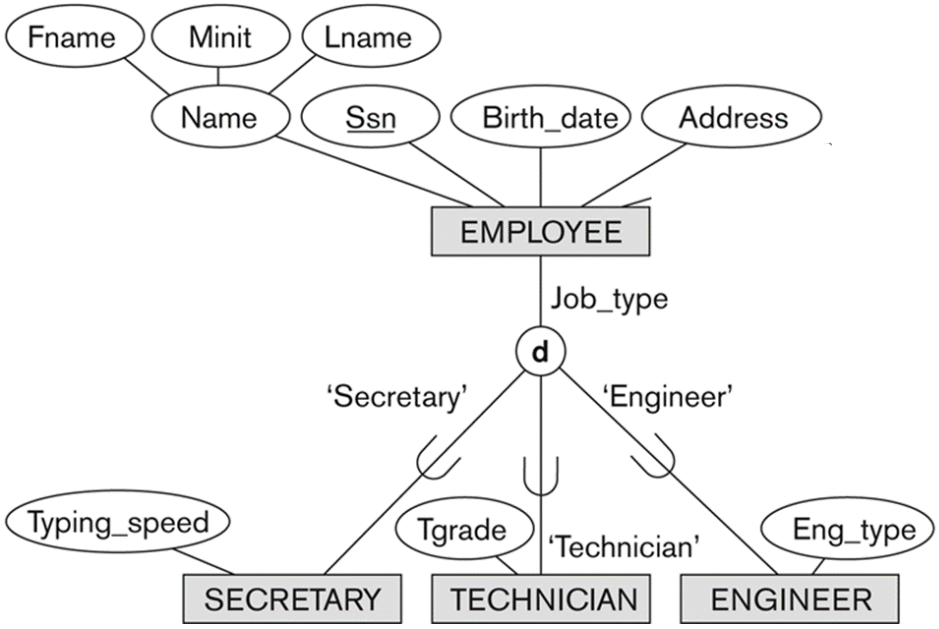
Options C (Single relation)

Option 8C:

- Create a single relation *L* with attributes *Attrs(L) = {k, a_1,…,a_n} U {attributes of S_i} U…U {attributes of S_m} U {t}* and *PK(L)=k*.
  - ***t*** is a type attribute that distinguishes amongst the different subclasses

This is for **disjoint** subclasses

Example



Option 8C

(c) Employee

SSN	FName	Minint	LName	BOD	Address	Job_type	Typing_ speed	Tgrade	Eng_ type

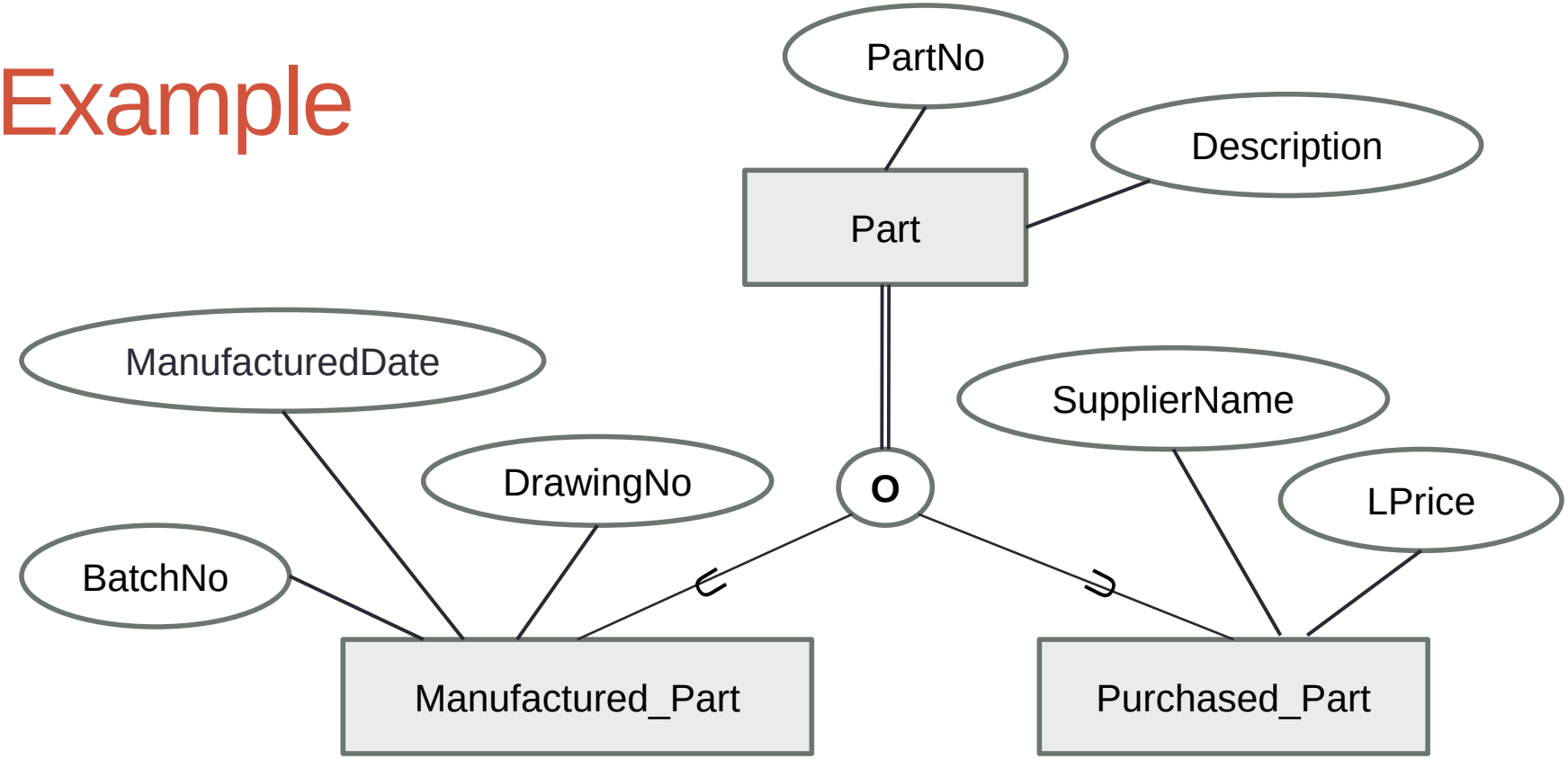
Options D (Single relation)

Option 8D:

- Create a single relation schema L with attributes *Attrs(L) = {k, $a_1,\ldots,a_n$} U {attributes of S_i} U… U {attributes of S_m} U {$t_1,\ldots,t_m$}* and *PK(L)=k*.
  - ***$t_1,\ldots,t_m$*** are type attributes

This is for **overlapping** subclasses

Example

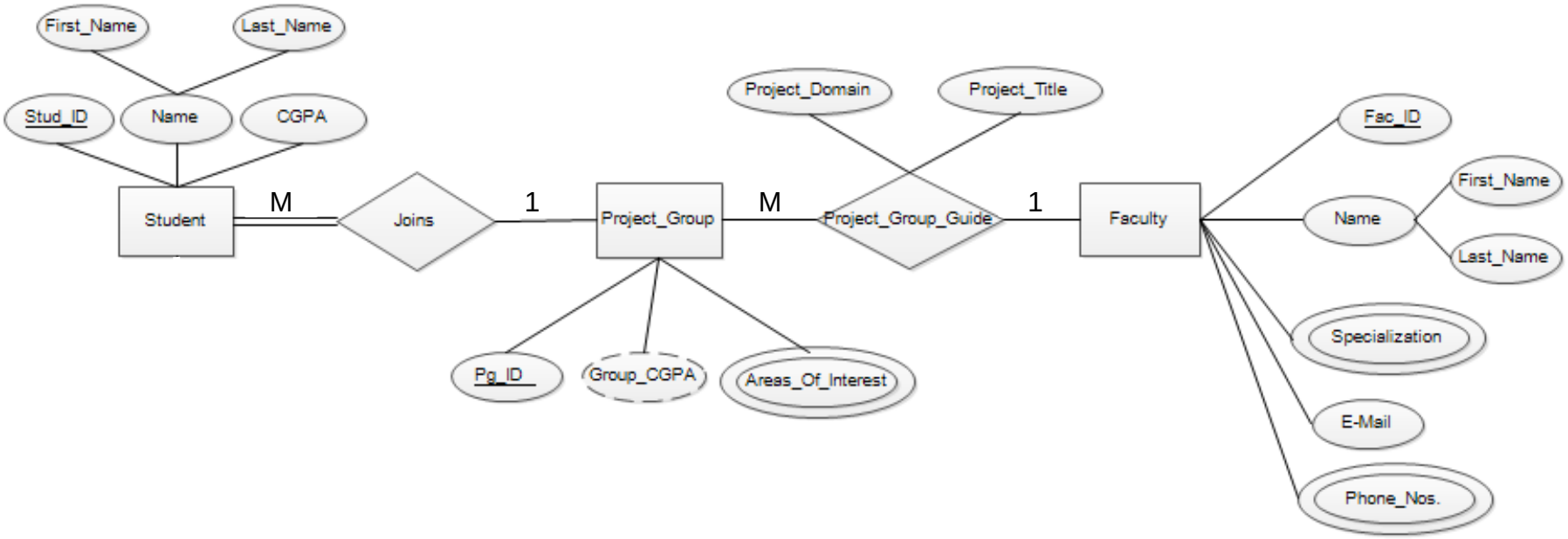


(d) Part

Part No	Description	MFlag	Drawing No	Manufactured Date	Batch No	PFlag	Supplier Name	LPrice

Option 8D

TASK


First_Name
Last_Name
Stud_ID
Name
CGPA
Student
M
Joins
1
Project_Group
Project_Domain
Project_Title
M
Project_Group_Guide
1
Faculty
Fac_ID
Name
First_Name
Last_Name
Specialization
E-Mail
Phone_Nos.
Pg_ID
Group_CGPA
Areas_Of_Interest