Reducing ER Diagrams to Relational Schemas

Database Design

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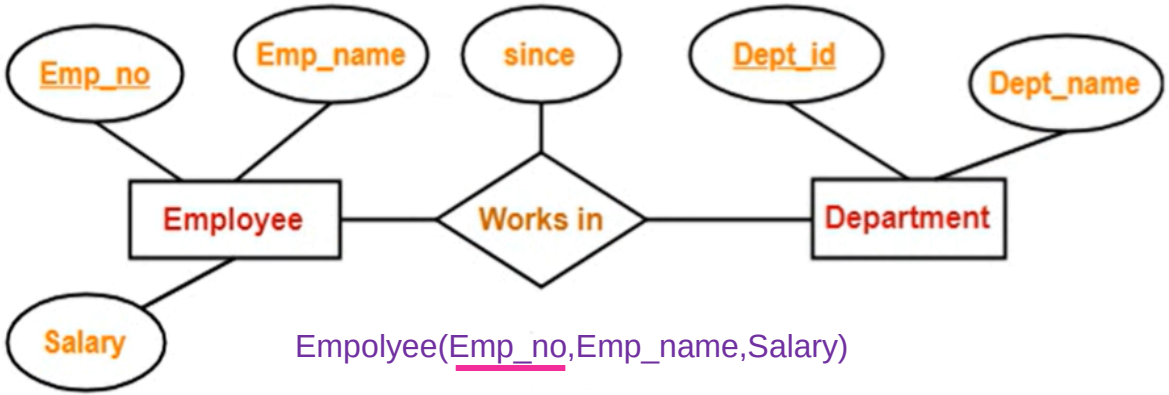
Translating Relationship Set into a Table

Relationship to Table

- One table for each entity type.
- One table for relationship type with:
  - Primary key of participating entity sets.
  - Its own descriptive attributes if any.
  - Set of non-descriptive attributes will be the primary key of this table.



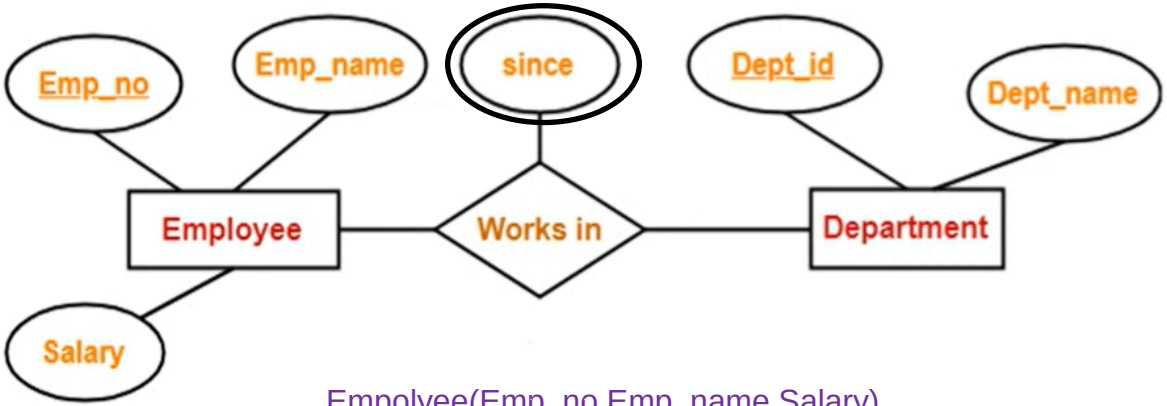
Empolyee(Emp_no,Emp_name,Salary)

Department(Dept_id,Dept_name)

Works_in(Emp_no,Dept_name,Since)

Relationship to Table

- If the relationship is unique by "since" attribute. "since" is a multivalued attribute, then its in the primary key of "Works_in" table.



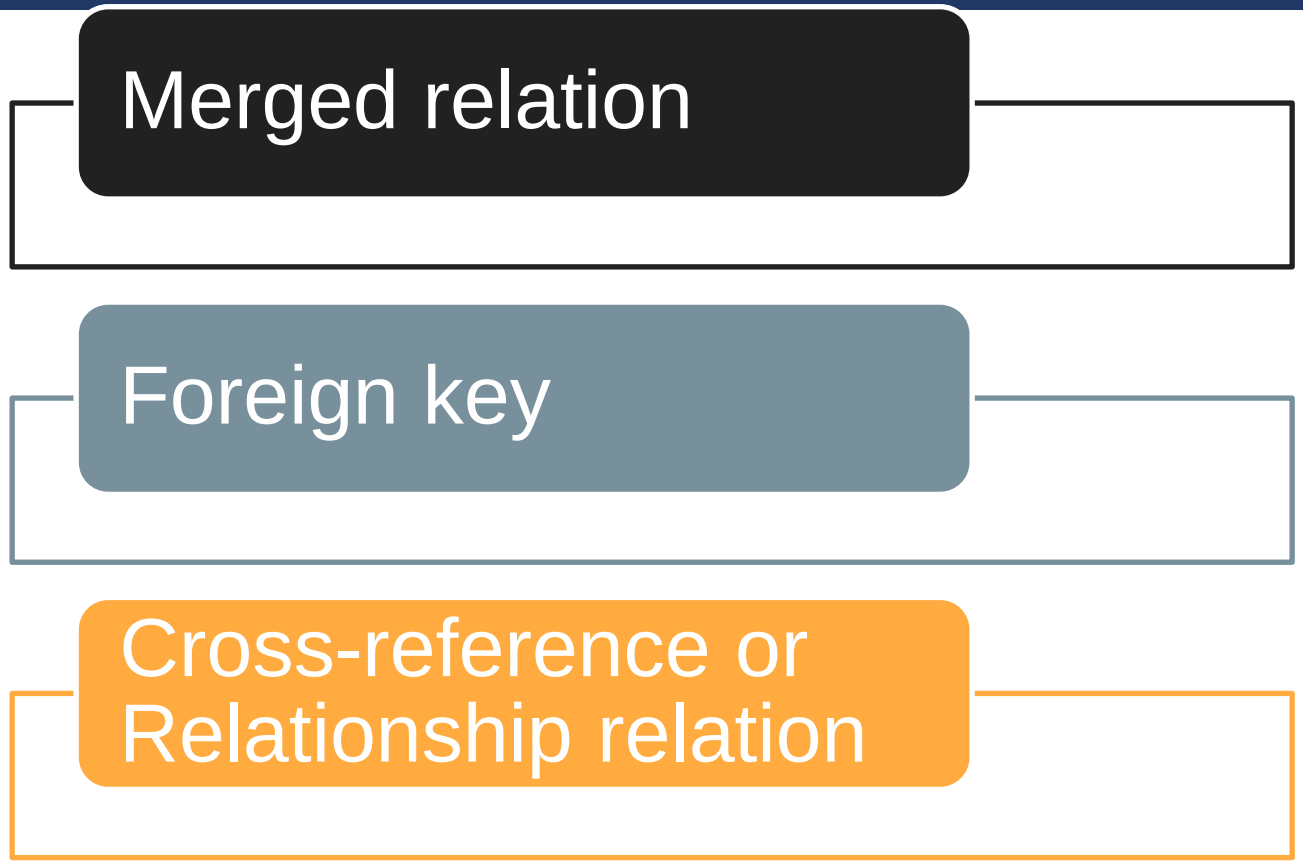
Empolyee(Emp_no,Emp_name,Salary)

Department(Dept_id,Dept_name)

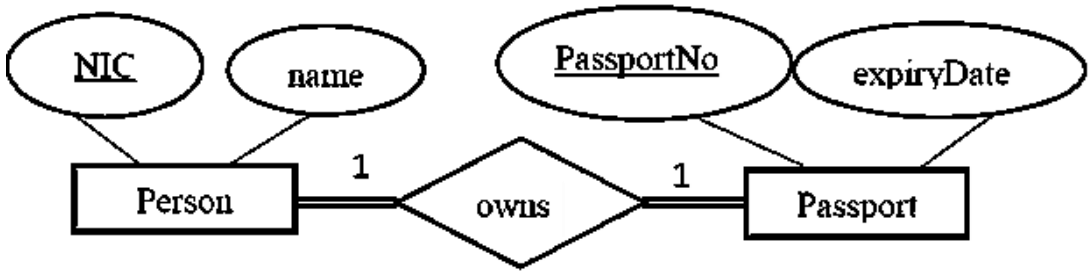
Works_in(Emp_no,Dept_name,Since)

1) Binary Relationship with Cardinality 1:1

Three Possible Approaches



1-1) Both sides Total Participation



Merged relation approach

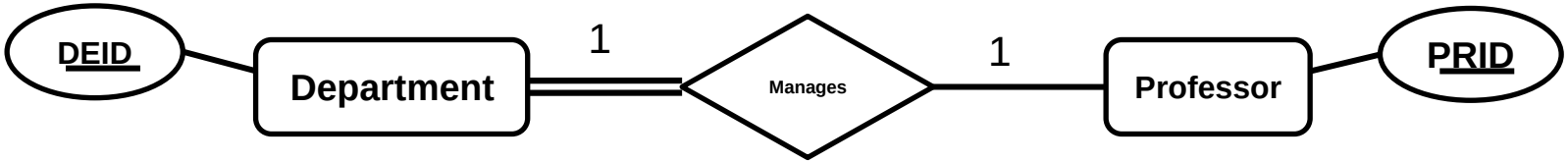
- One table by combine both entities and relationship.
- Assign one PK from any of the entity types.

Person_passport(NIC,name,PassportNo,expiryDate)

OR

Person_passport(NIC,name,PassportNo,expiryDate)

1-2) One side Total Participation



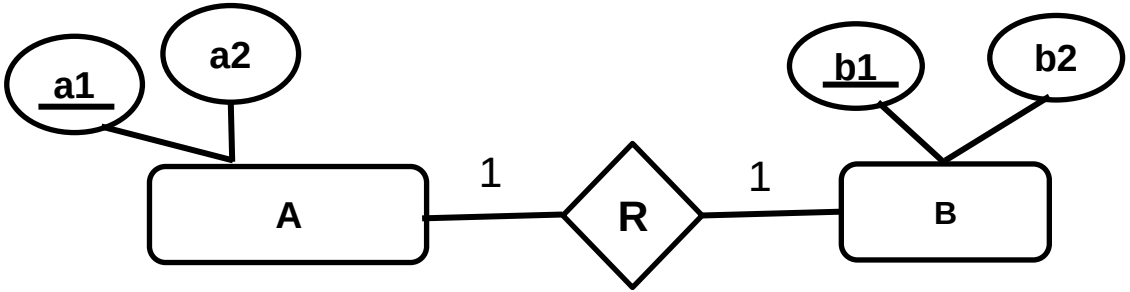
Foreign key approach

- Two table.
- PK must to go Total Participation side as FK.

Department(DEID , PRID)

Professor(PRID)

1-3) Both side Partial Participation



Merged relation approach

- PK can go to either side.

A (a1 , a2)

BR (b1 , b2 , a1)

OR

AR (a1 , a2 , b1)

B (b1 , b2)

Cross-reference approach

- When number of participations are very low, maybe three table will be better to avoid null values:

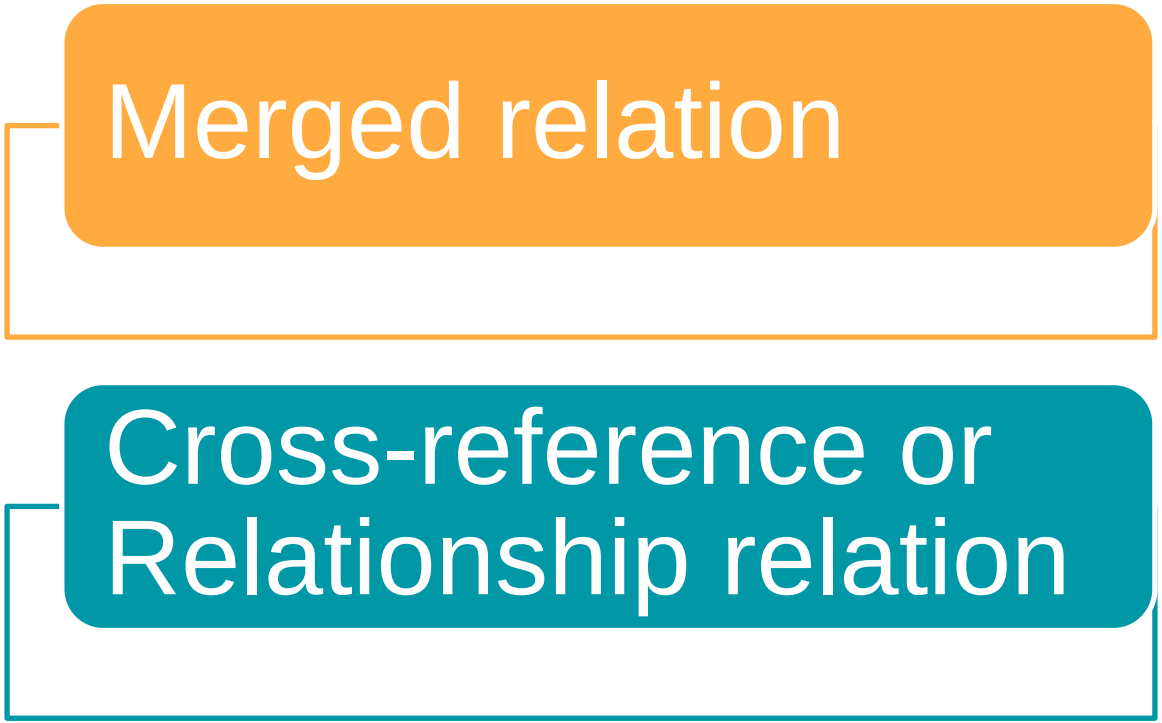
A (a1 , a2)

B (b1 , b2)

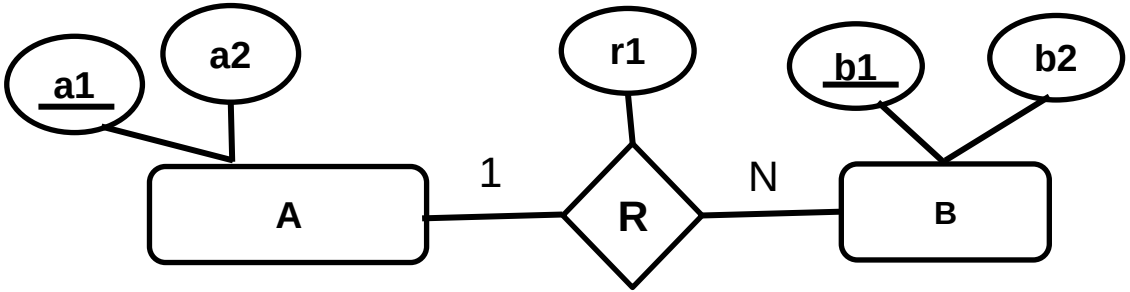
R (a1,b1)

2) Binary Relationship with Cardinality 1:N

Two Possible Approaches



2-1) Strong Entity Types

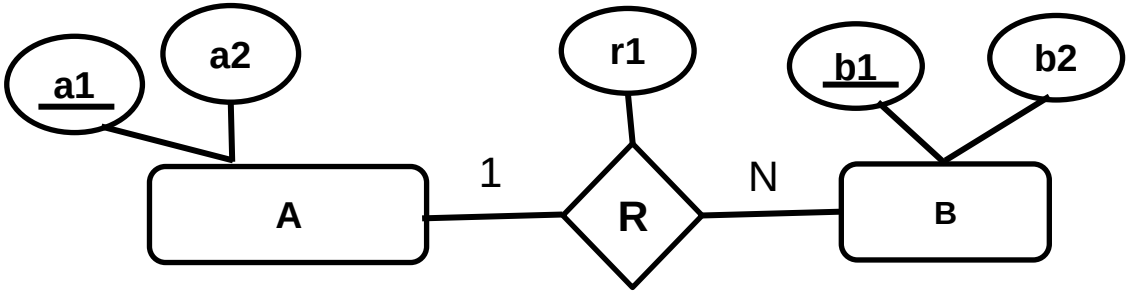


- First solution: Merged relation approach
  - PK of 1 side go to N side
  - Note: If there are any descriptive attributes they also go to the N side (Wherever the FK goes, descriptive attributes goes there)

A (a1 , a2)

BR (b1 , b2 , a1, r1)

2-1) Strong Entity Types



- Second solution: Cross-reference approach
  - Three tables:

    A (a1 , a2)

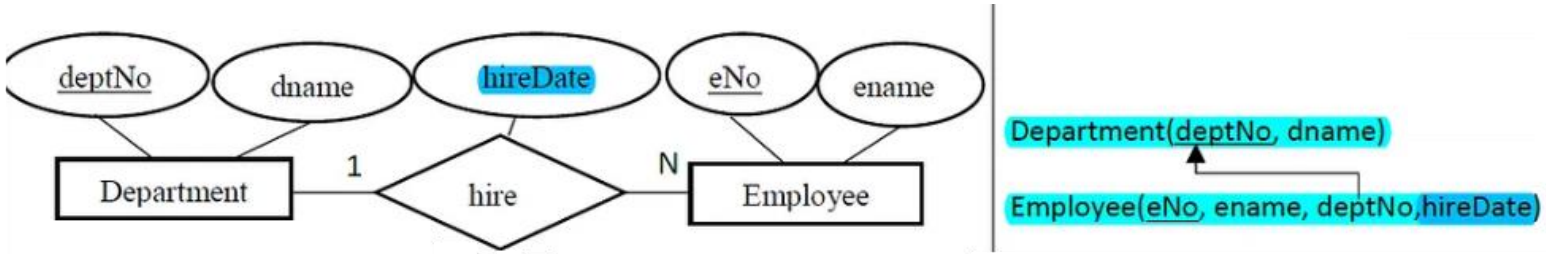
    B (b1 , b2)

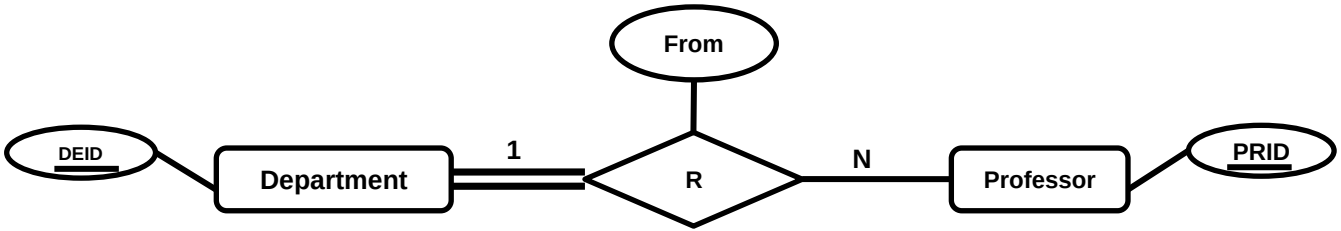
    R (a1,b1,r1)

- When second solution is preferred?
  - To avoid null values in table BR: Number of B entity set not participated in R relationship is large.
  - The frequency of reference to the relation "R" is high while other attributes with a lower frequency are needed.
  - Attributes of entity type B is too large.

2-1) Strong Entity Types

- Examples

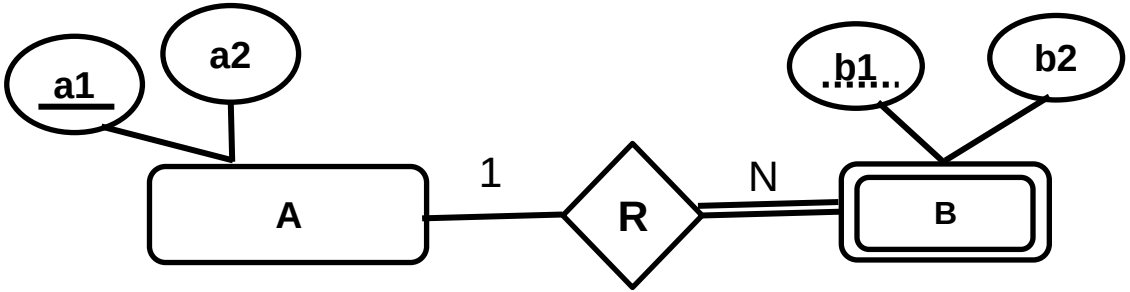




DEP (DEID)

PRO (PRID , DEID, From)

2-2) Strong Entity Type and Weak Entity Type



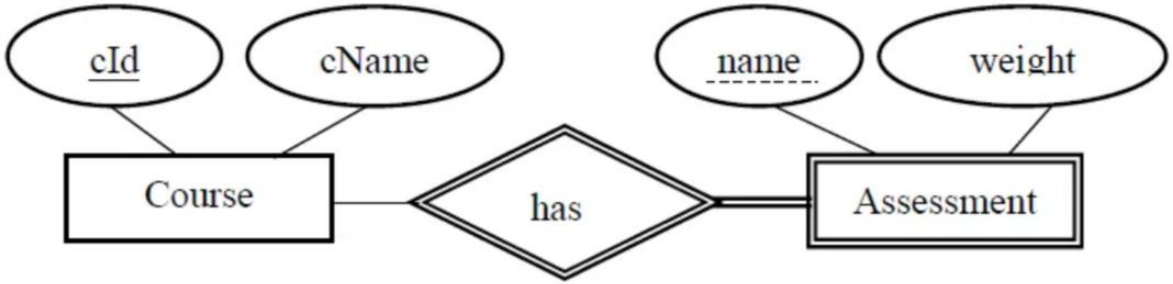
- PK of Owner Entity goes to combine with the Partial Key of the Weak Entity to form the PK.

A (a1 , a2)

B (b2 , b1 , a1)

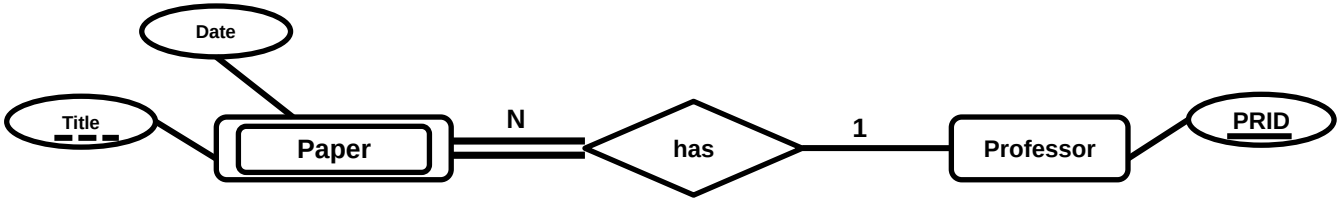
2-2) Strong Entity Type and Weak Entity Type

- Examples



Course (cId, cName)

Assessment (cId, name,weight)

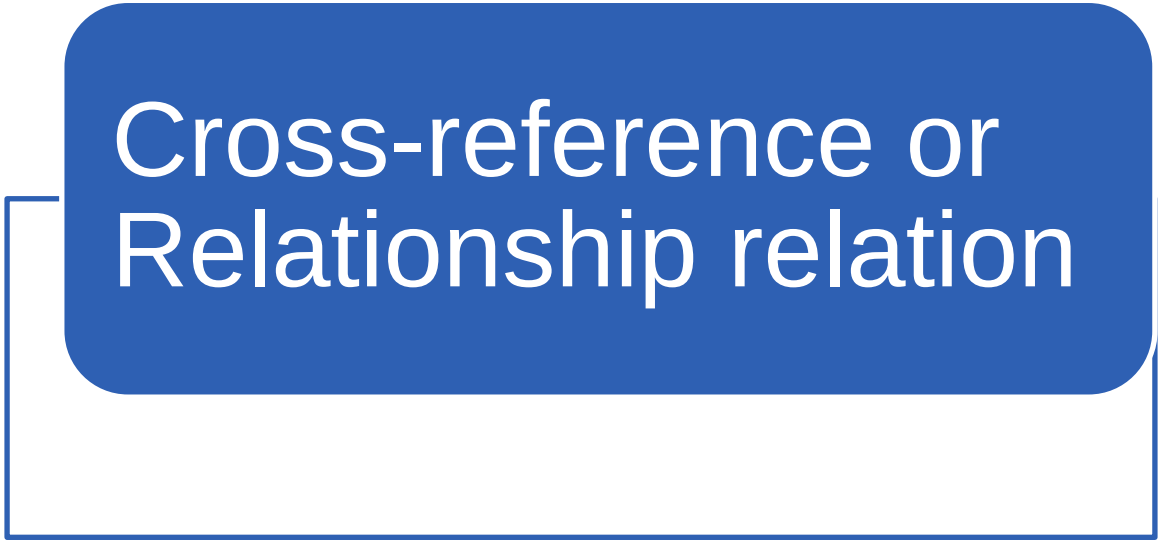


Paper (PRID,Title,Date)

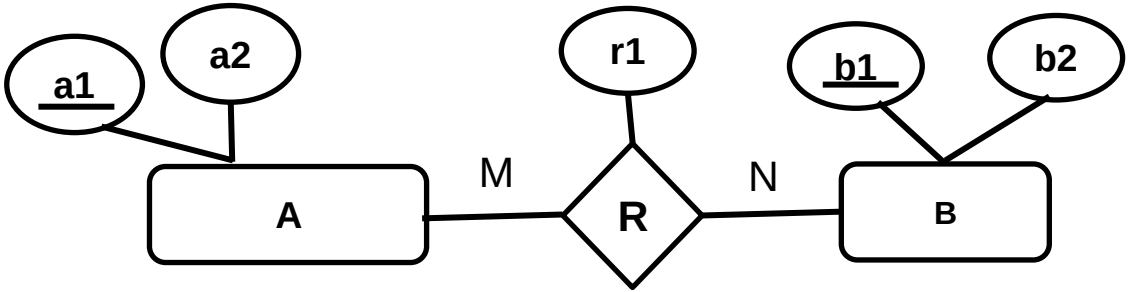
Professor (PRID)

3) Binary Relationship with Cardinality M:N

One Possible Approaches



3-1) Single Attribute for Relationship



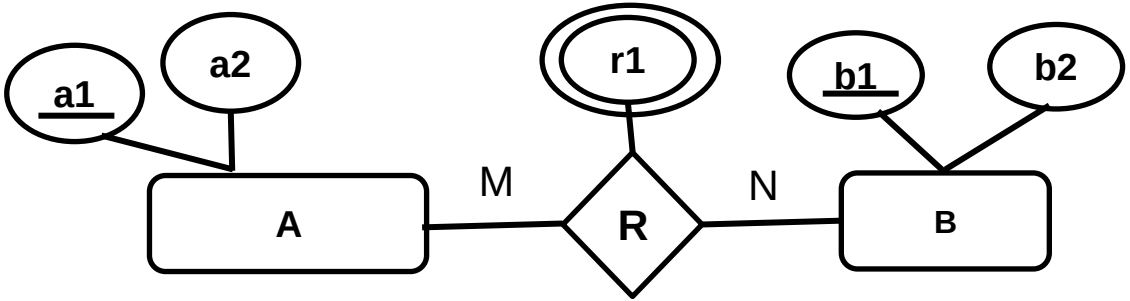
- A table/relation for the Relationship is created including the PK's of the participating entities and descriptive attributes, if any.

A (a1 , a2)

B (b1 , b2)

R (a1 , b1 , r1)

3-1) Multivalued Attribute for Relationship

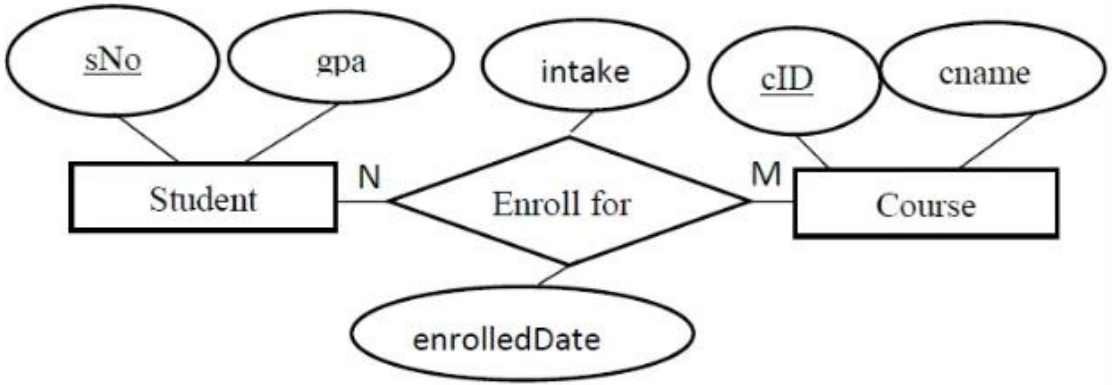


A (a1 , a2)

B (b1 , b2)

R (a1 , b1 , r1)

Examples



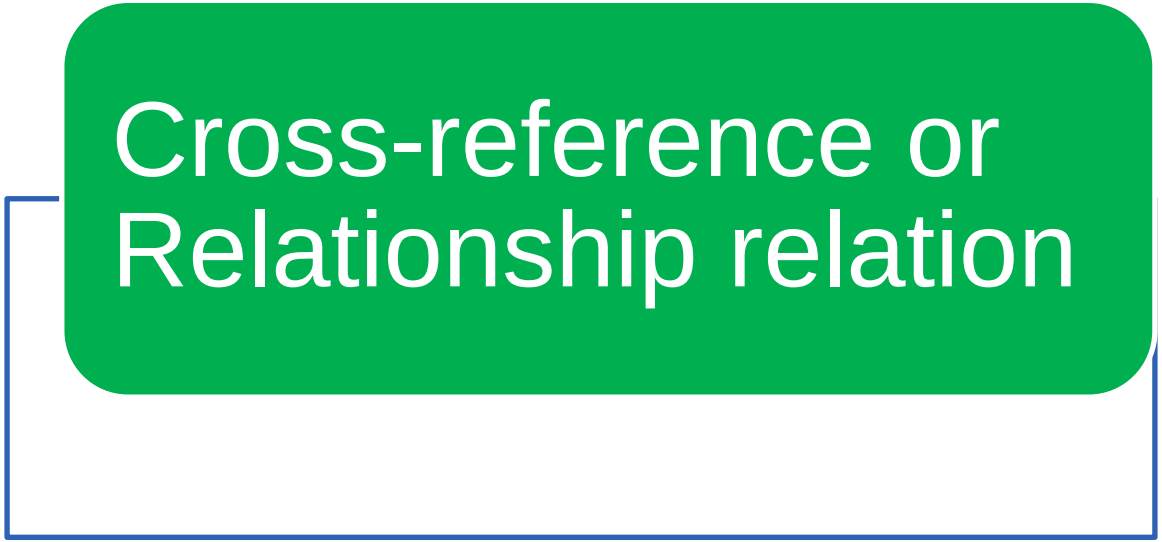
Student (sNo, gpa)

EnrollFor (sNo,cID, intake, enrolledDate)

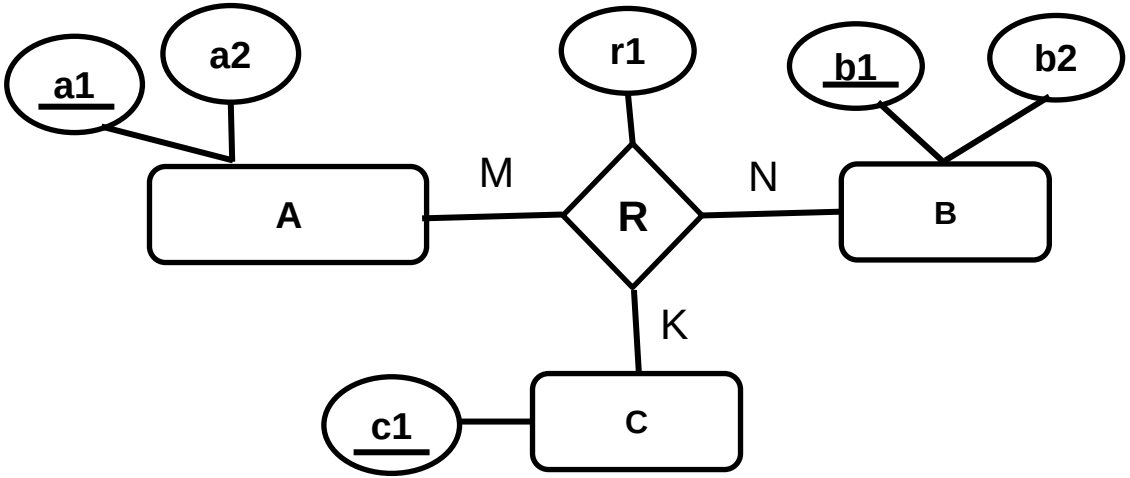
Course (cID, cname)

4) Ternary Relationship with Cardinality M:N:K

One Possible Approaches



4-1) Single Attribute for Relationship



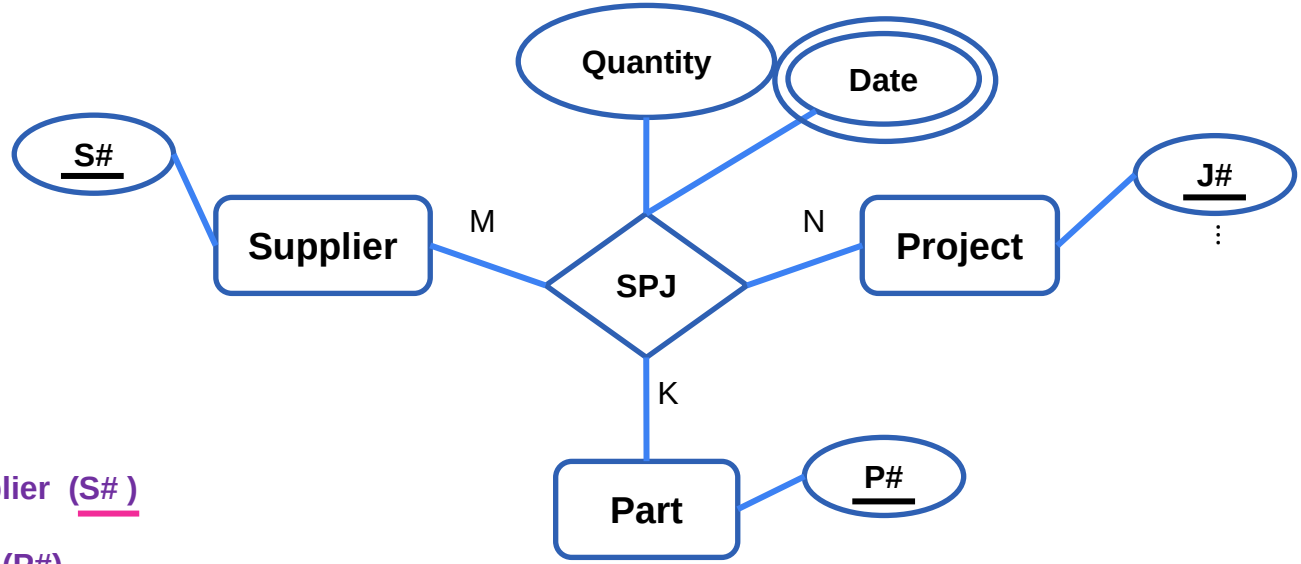
A (a1 , a2)

B (b1 , b2)

C (c1)

R (a1 , b1 , c1 , r1)

Example: Multivalued Attribute for Relationship



Supplier (S#)

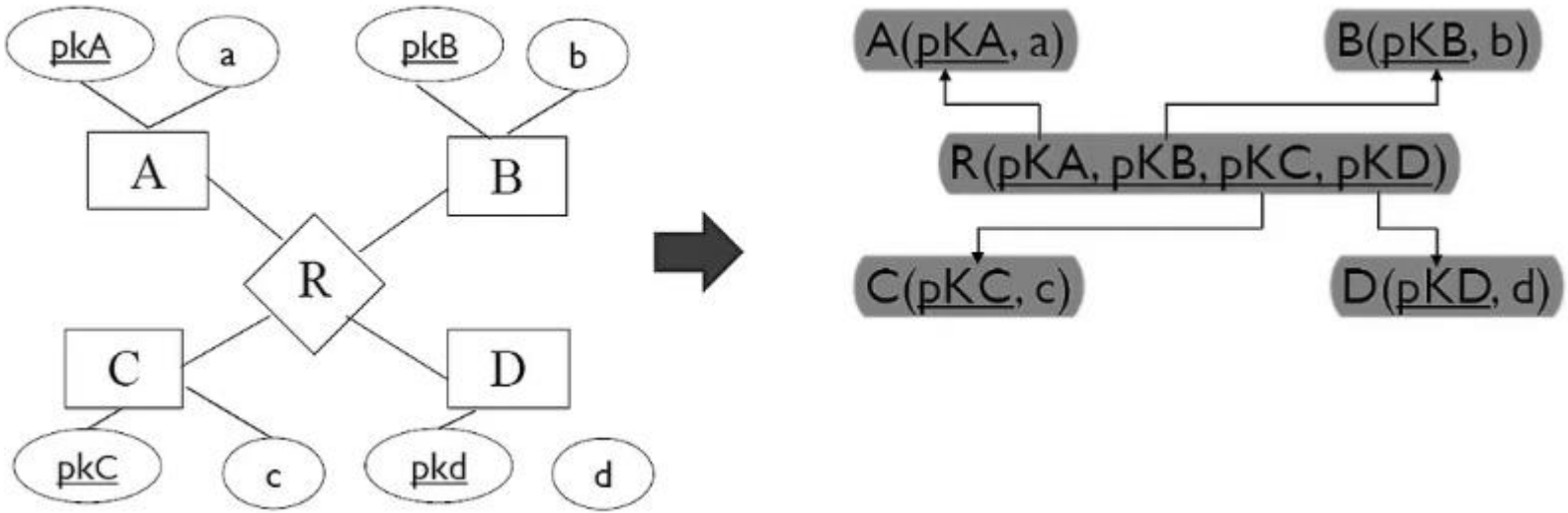
Part (P#)

Project (J#)

SPJ (S# , J# , P# , Date, Quantity)

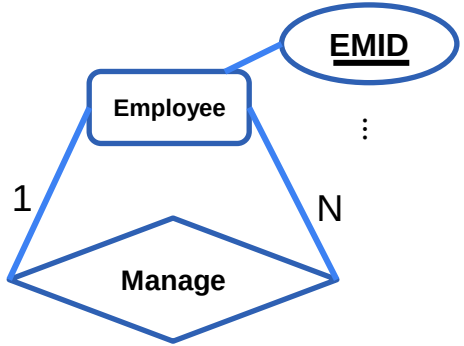
5) N-ARY Relationship

- N-ary relationship is mapped in to a "Relationship" relation and foreign keys.
  - "N" means Degree greater than 2
  - Degree = No of Entities attached to the relationship.



6) Unitary Relationship with Cardinality 1:N

1:N Unitary Relationship

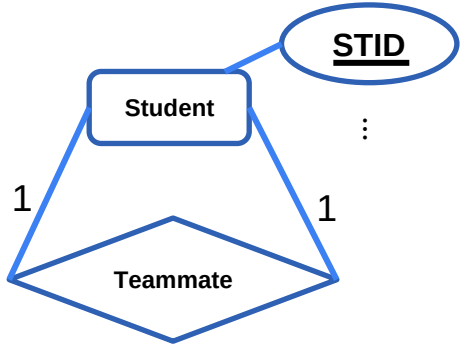


- One table:

EMPL (EMID , EMGRID)

7) Unitary Relationship with Cardinality 1:1

1:1 Unitary Relationship



- Solution for when there are not many people without group members.

EMPL (EMID , EMGRID) — Unique

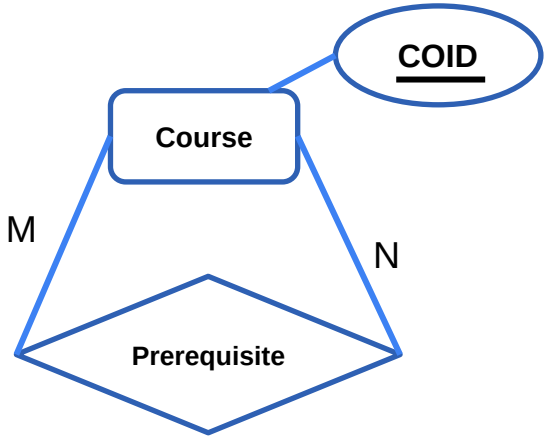
- Solution for when there are many people without group members.

EMPL (EMID)

TEAMMATE (EMID , EMGRID) — Unique

8) Unitary Relationship with Cardinality M:N

M:N Unitary Relationship

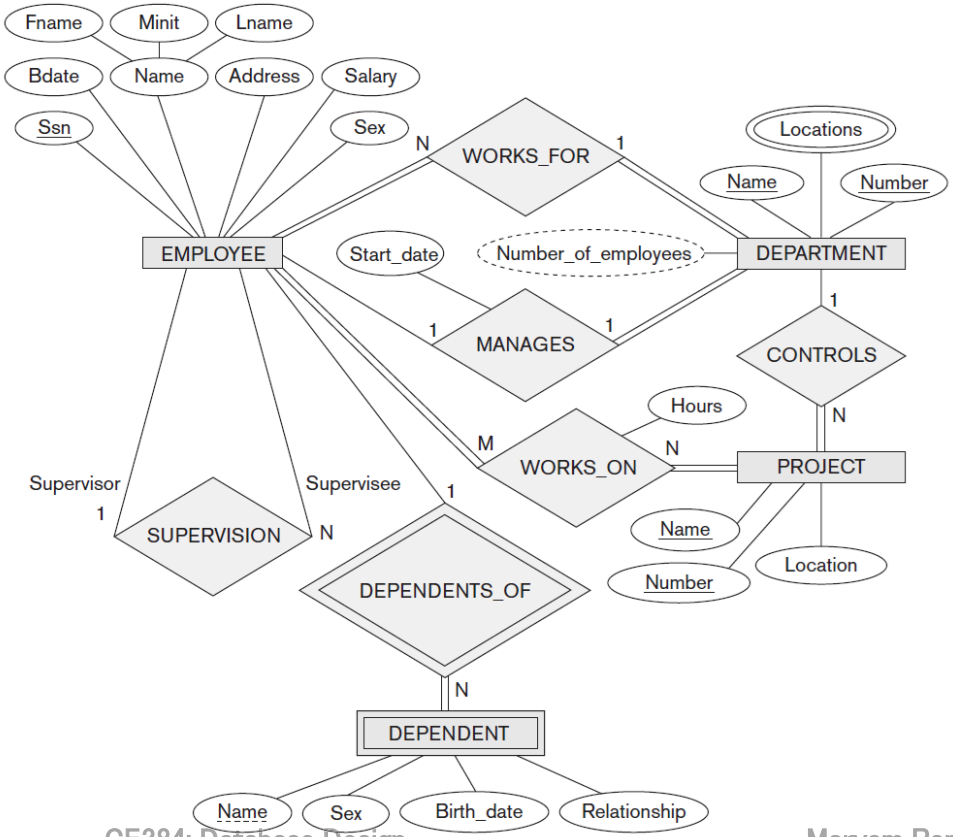


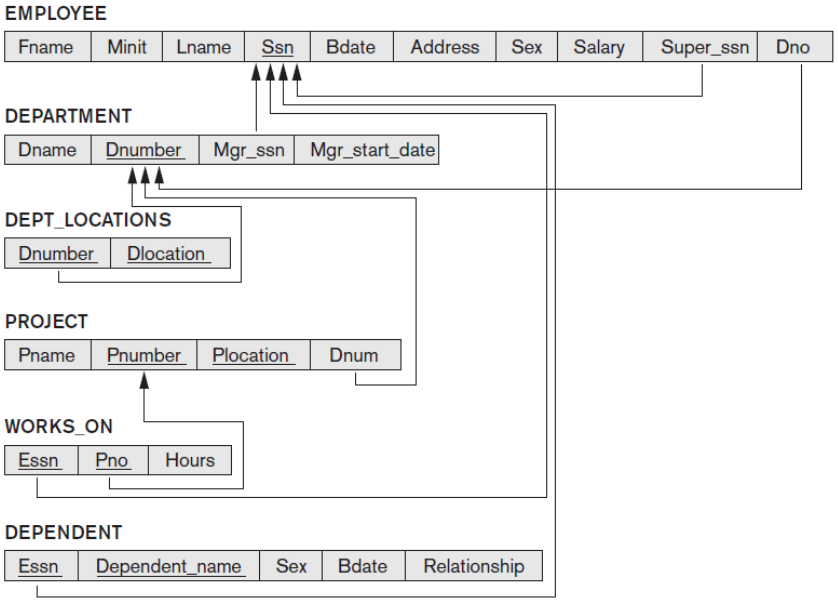
- Two tables:

Prerequisite (COID , PRECOID)

Course (COID)

Example


Fname
Minit
Lname
Bdate
Name
Address
Salary
Ssn
Sex
N
WORKS_FOR
1
Locations
Name
Number
EMPLOYEE
Start_date
Number_of_employees
DEPARTMENT
1
1
MANAGES
1
CONTROLS
N
Hours
M
WORKS_ON
N
PROJECT
Supervisor
1
Supervisee
1
SUPERVISION
N
DEPENDENTS_OF
Name
Number
Location
N
DEPENDENT
Name
Sex
Birth_date
Relationship


EMPLOYEE
Fname
Minit
Lname
Ssn
Bdate
Address
Sex
Salary
Super_ssn
Dno
DEPARTMENT
Dname
Dnumber
Mgr_ssn
Mgr_start_date
DEPT_LOCATIONS
Dnumber
Dlocation
PROJECT
Pname
Pnumber
Plocation
Dnum
WORKS_ON
Essn
Pno
Hours
DEPENDENT
Essn
Dependent_name
Sex
Bdate
Relationship

Conclusion

- Correspondence between ER and Relational Models

ER MODEL	RELATIONAL MODEL
Entity type	*Entity* relation
1:1 or 1:N relationship type	Foreign key (or *relationship* relation)
M:N relationship type	*Relationship* relation and *two* foreign keys
n-ary relationship type	*Relationship* 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

References

- Chapter 9 of FUNDAMENTALS OF Database Systems, SEVENTH EDITION
- Chapter 6 Part 7 of DATABASE SYSTEM CONCEPTS, S I XTH E D I T I ON.
- Chapter 4 of Database Systems A Practical Approach to Design, Implementation, and Management, SIXth edition