MAPPING ER DIAGRAMS TO RELATION DATA MODEL

- Conceptual ER-models allow you to more accurately represent the subject area than logical models (relational, network, etc.).
- But, there are no DBMSs that support ER models.
- So, ER diagram is converted into the tables in Relational Data Model (RDM or RM).
- Relational models can be easily implemented by RDBMS like mySQL, MS SQL, PostgreSQL, Oracle etc. With CASE Tools usage.

The ER2RDM mapping method is based on the formation of a set of initial relation tables from ER-diagrams (initial logical model) and based on this factors – **atomic and multivalued** of attribute, **cardinality** (max=one-many) **and obligation** (min=optional-mandatory) of relationship.

At the next stage, the initial logical RD model are optimized (normalized).

1. ER2RDM MAPPING BRIEFLY

- A table is created for each entity:
  01) Each simple entity attribute corresponds to **a current table** column, derived entity attribute removed from **a current table**;
  02) Each element of composite attribute corresponds to **a current table** column;
  03) Each multivalued attribute **+1 separate table** will require.
- For Binary Relationship With Weak Entity Set:
  04) – **2 tables** for 2 entity will require.
- For a relationship without cardinality ratios description:
  05) – **3 tables** will require.
- For a relationship of type m:n, there are only 1 rule:
  06) relationship n:m – **3 tables** for 2 entity will require.
- For type 1:m relationship, there are 2 separate rules:
  07) relationship 1,1:1,m or 0,1:1,m – **2 tables** for 2 entity will require;
  08) relationship 1,1:0,m or 0,1:0,m – **3 tables** for 2 entity will require.
- For a 1:1 relationship, there are 3 separate rules for generating preliminary tables from ER diagrams; (min,max:min,max) notation use:
  09) relationship 1,1:1,1 – **1 table** for 2 entity will require (Employee -||---||- Badge => EmployeeBadge);
  10) relationship 1,1:0,1 or 0,1:1,1 – **2 tables** for 2 entity will require (Manager -||---O|- Branch => Manager + Branch);
  11) relationship 0,1:0,1 – **3 tables** for 2 entity will require (Manager -|O---O|- Branch => Manager + ManagerBranch + Branch).

1.1. SUMMARY OF CONVERSION RULES FOR RELATIONSHIP.

Cardinality	Membership Class	Number of Relations	Notes
1 : 1	Both Mandatory	**1**	all attributes in a single table
1 : 1	One Mandatory One Optional	**2**	Identifier of optional entity held in the mandatory entity relation
1 : 1	Both Optional	**3**	one relation for each entity and the relationship between them
1 : N	Both Mandatory	**2**	One relation for each entity and identifier of "one" end held in "many" end entity relation
1 : N	One Mandatory One Optional	**2**	*if the many end is mandatory*: one relation for each entity and identifier of the optional entity (the "one" end) held in the mandatory entity relation (the "many" end)
1 : N	One Mandatory One Optional	**3**	*if the many end is optional*: one relation for each entity and one for the relationship between them
1 : N	Both Optional	**3**	one relation for each entity and one for the relationship between them
M : N	Both Mandatory	**3**	one relation for each entity and one for the relationship between them
M : N	One Mandatory One Optional	**3**	one relation for each entity and one for the relationship between them
M : N	Both Optional	**3**	one relation for each entity and one for the relationship between them

←The following table provides a summary of the guidelines for converting components of an ERD into relations.

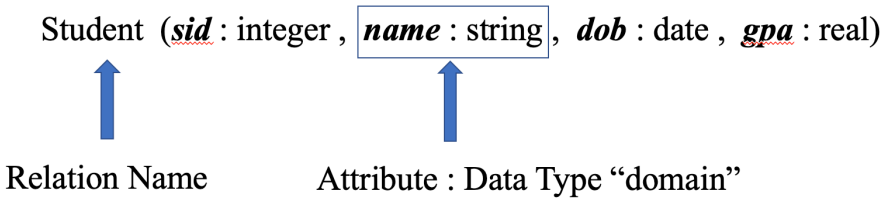
We need to be certain that if we store an identifier for one entity in a relation representing another entity, that the **identifier never has a null value**. If we have a null value for an identifier, we will never be able to find the other details that should be associated with it.

2. ER2RDM MAPPING RULES

2.0. THE DATABASE RELATION SCHEMA.

The schema specifies the relation's name, the name of each field (or column, or attribute), and the domain of each field.

The student information in a university database may be stored in a relation with the ***following schema***:



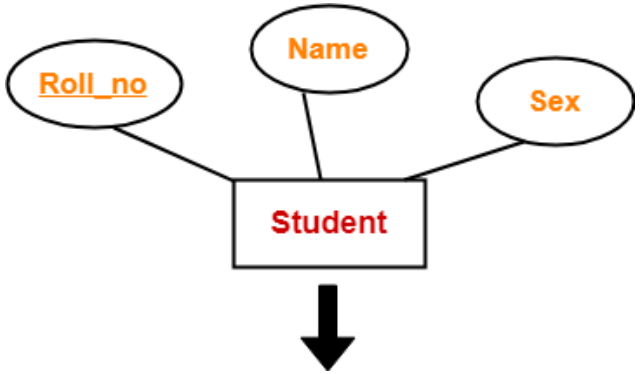
(GPA – Grade Point Average, DOB – Date of Birth)

Following 11 rules are used for converting an ER diagram into RM schema.

2.1. Rule-01: For Strong Entity Set With Only Simple Attributes

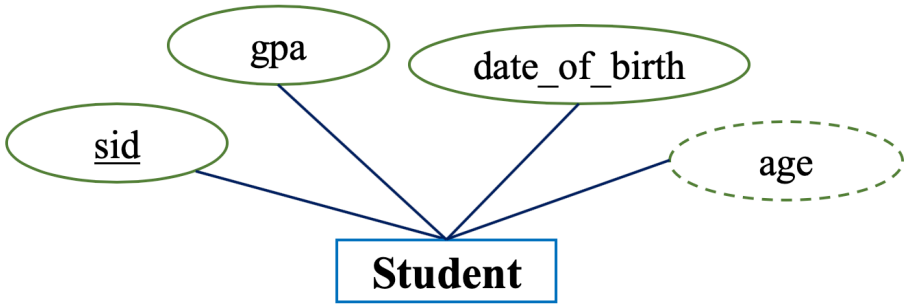
- A **strong entity set with only simple attributes** will require **only 1 table** in relational model.
- Attributes of the table will be the attributes of the entity set.
- Derived attributes removed from the table.
- The primary key of the table will be the key attribute of the entity set.

Examples



Roll_no	Name	Sex

Schema: Student(Roll_no, Name, Sex)



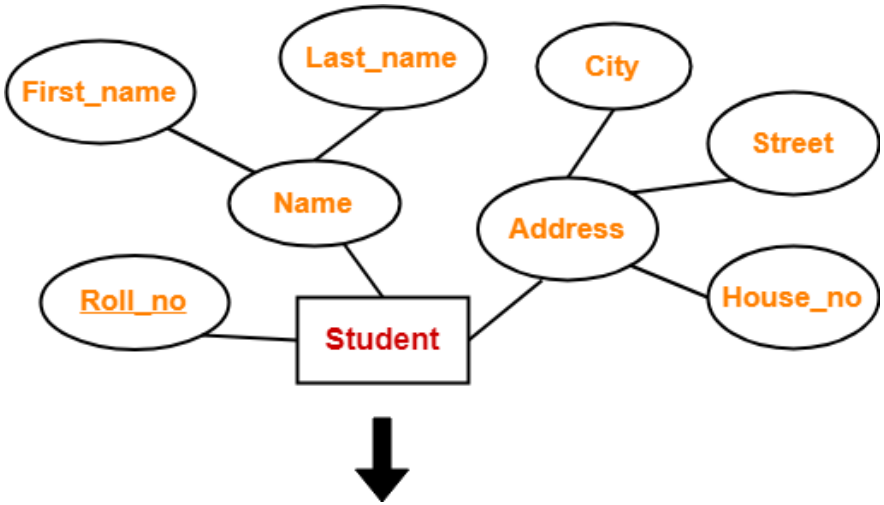
sid	gpa	date_of_birth

Schema: Student(sid, gpa, date_of_birth)

2.2. Rule-02: For Strong Entity Set With Composite Attributes

- A **strong entity set with any number of composite attributes** will require **only 1 table** in relational model.
- While conversion, simple attributes of the composite attributes are taken into account and not the composite attribute itself.

Example



Roll_no	First_name	Last_name	House_no	Street	City

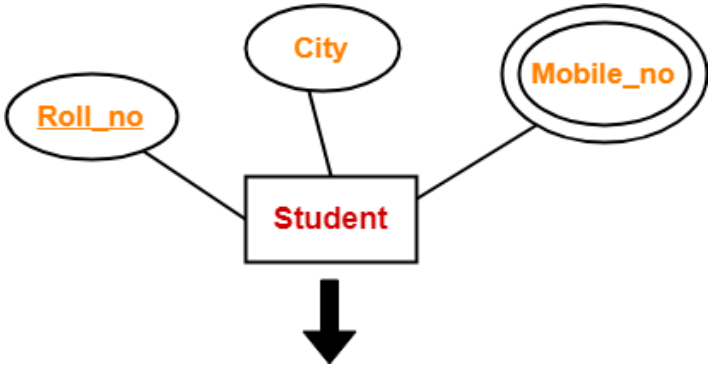
Schema: Student(Roll_no, First_name, Last_name, House_no, Street, City)

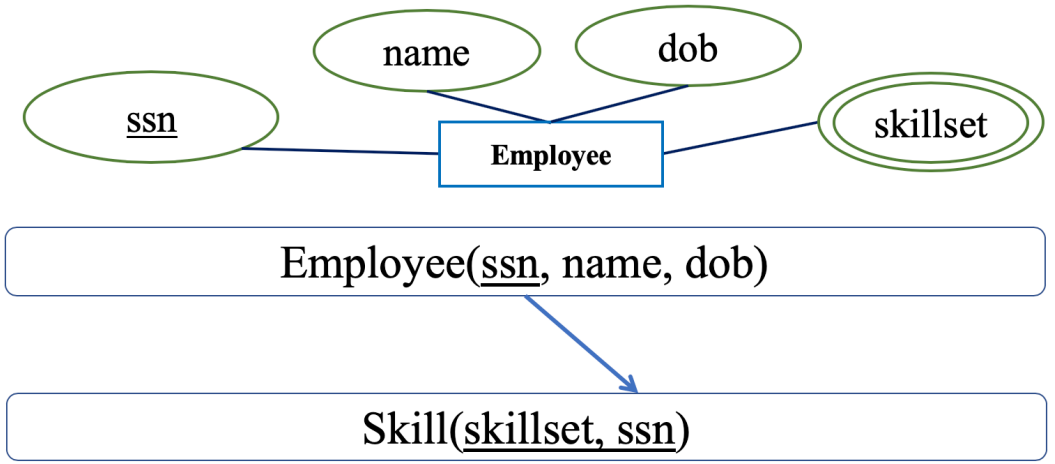
Roll numbers are unique identification numbers that can be assigned to students at the time of admission or after admission. To avoid instances of students of different batches (party) having the same roll numbers, you can set a common prefix to all student roll numbers of each batch (party).

2.3. Rule-03: For Strong Entity Set With Multivalued Attributes

- A **strong entity set with any number of multivalued attributes** will require **2 tables** in relational model.
- One table will contain all the simple attributes with the primary key.
- Other table will contain the primary key and all the multivalued attributes.

Examples



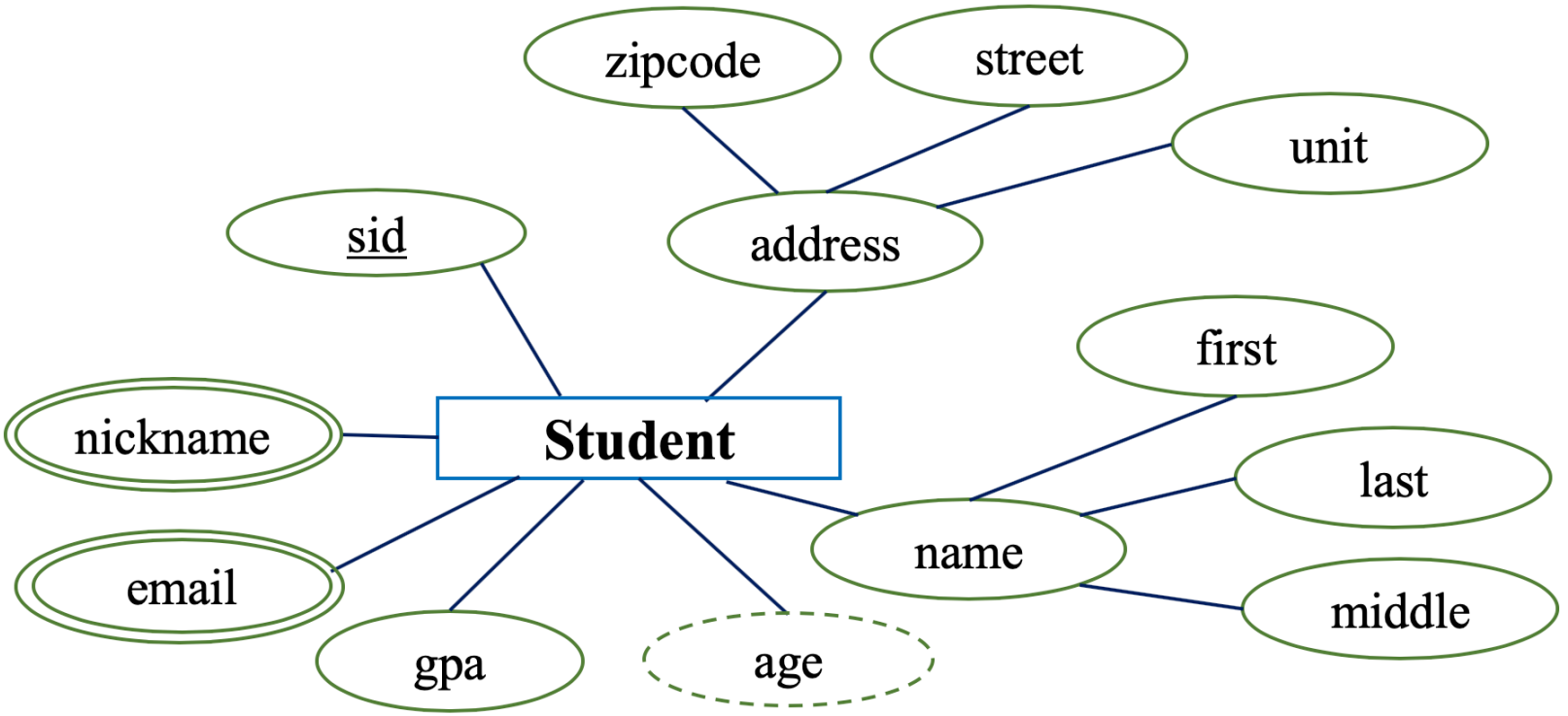


Key Attribute Migration (tranzition).

Roll_no	City
PK	

Roll_no	Mobile_no
PK,FK	PK

TASK. BUILD A RELATIONAL SCHEMA FROM THE FOLLOWING ER DIAGRAM:

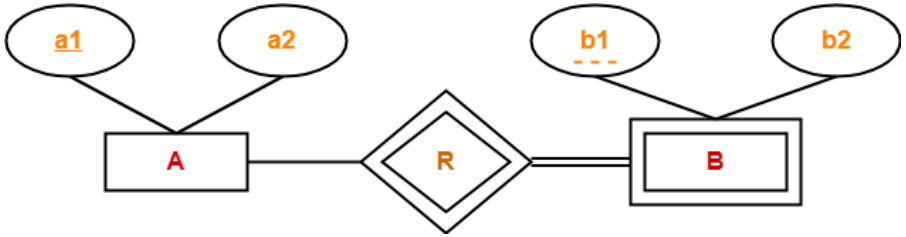


Student(<u>sid</u>, zipcodeAddr, streetAddr, unitAddr, firstName, middleName, lastName, gpa, dob)
Nickname(<u>sid</u>, <u>nickname</u>)
Email(<u>sid</u>, <u>email</u>)

2.4. Rule-04: For Binary Relationship With Weak Entity Set.

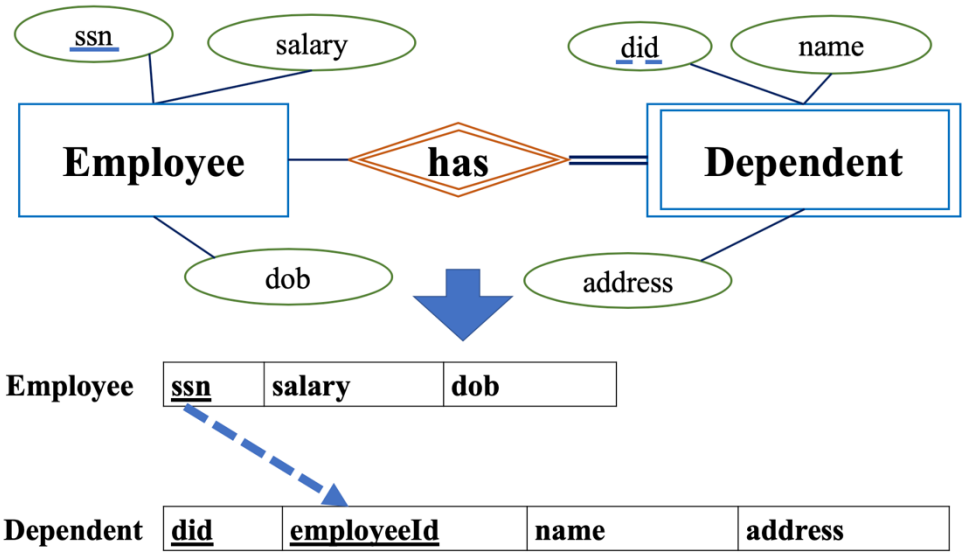
Weak entity set always appears in association with identifying relationship with total participation constraint.

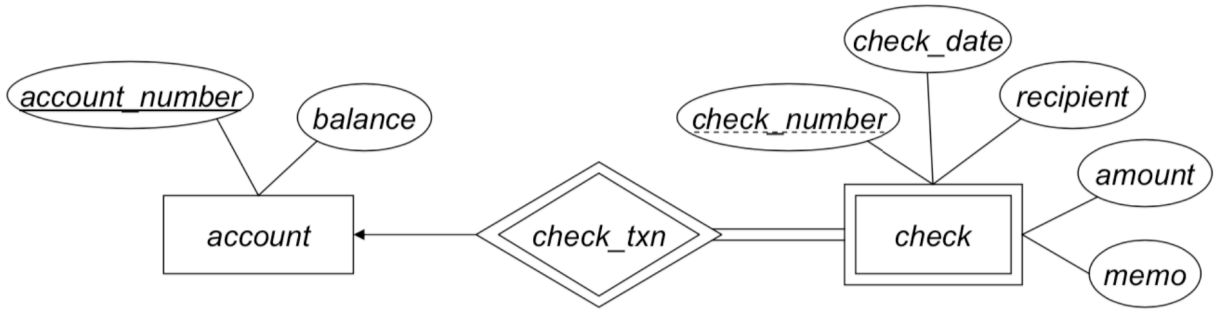
Examples



Here, **2 tables** will be required

1. A(a1, a2)
2. BR(a1, b1, b2)





account(*account_number*, *balance*)

check schema:

Discriminator is *check_number*

Primary key for *check* is: (*account_number*, *check_number*)

check(*account_number*, *check_number*, *check_date*, *recipient*, *amount*, *memo*)

2.5. Rule-05: Translating Relationship Set Without Cardinality Ratios Description into a Table

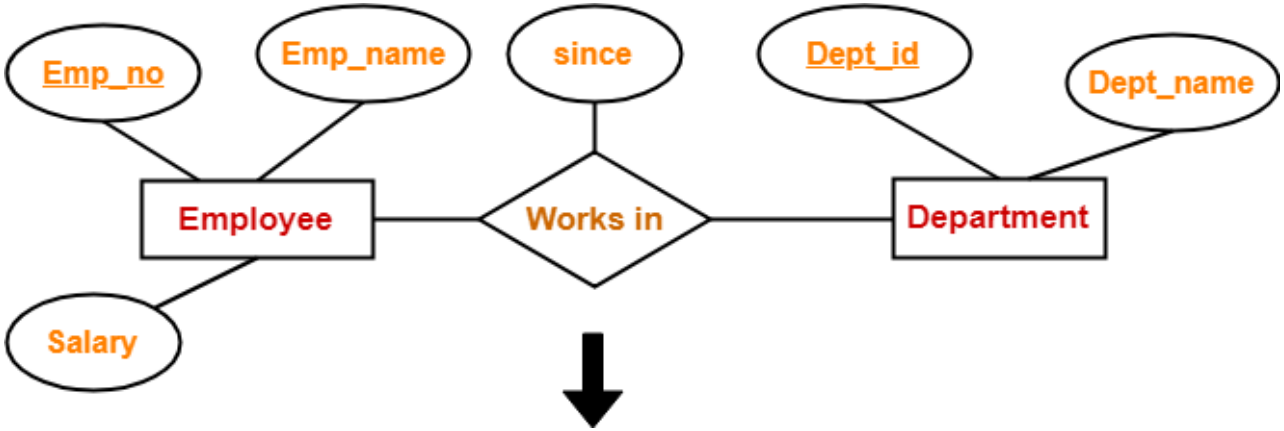
A relationship between 2 relations will require **3 tables** in the relational model.

Attributes of the table are

- Primary key attributes of the participating entity sets
- Its own descriptive attributes if any.

Set of non-descriptive attributes will be the primary key.

Example



Emp_no	Dept_id	since

Schema: WorksIn(Emp_no, Dept_id, since)

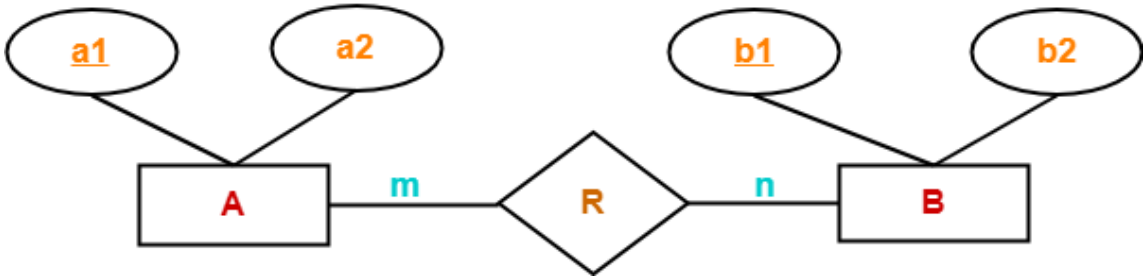
Note.

If we consider the overall ER diagram, 3 tables will be required

- One table for the entity set “Employee”
- One table for the entity set “Department”
- One table for the relationship set “WorksIn”

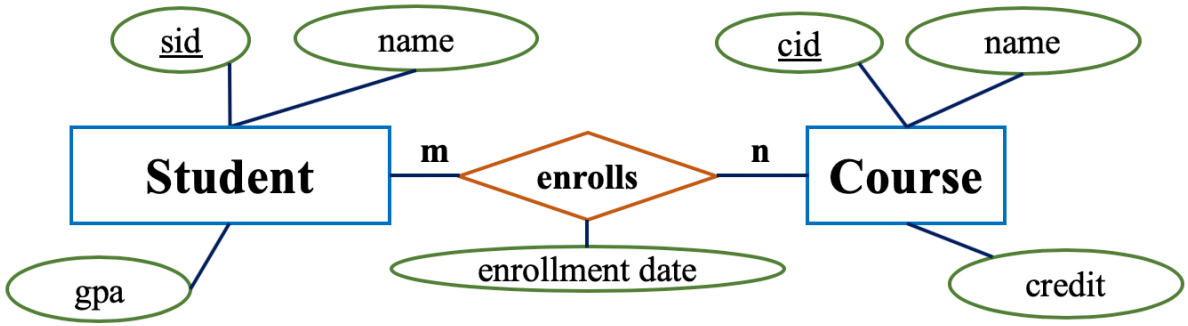
2.6. Rule-06: For Binary Relationship With Cardinality Ratio M:N

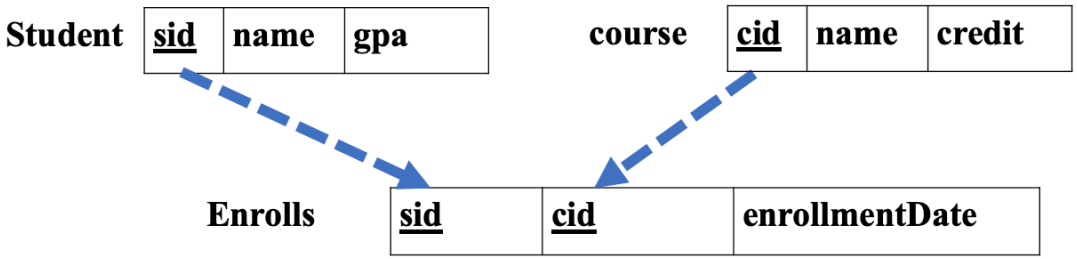
Examples



Here, **3 tables** will be required

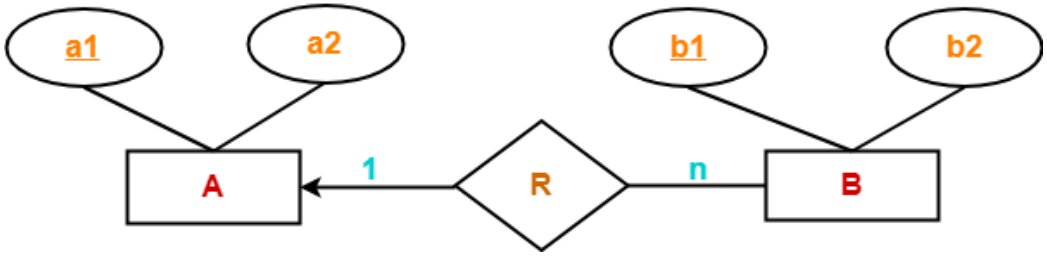
1. A(a1, a2)
2. R(a1, b1)
3. B(b1, b2)

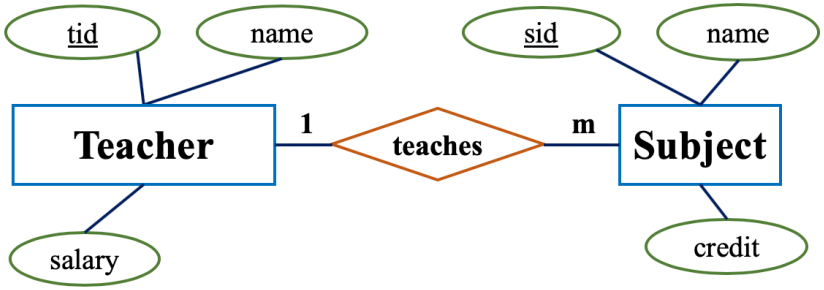


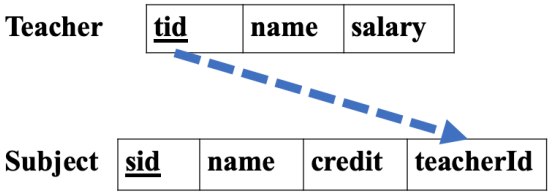


2.7. Rule-07: For Binary Relationships With Cardinality Ratio 1:1,N or 1,M:1

2.7.1. Case-01: For Binary Relationship With Cardinality Ratio 1:1,N





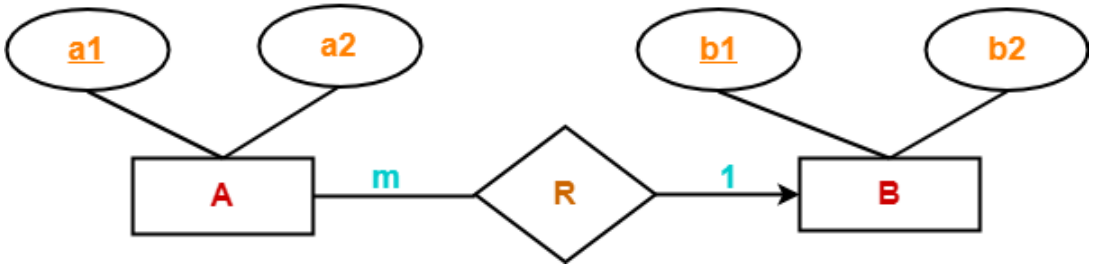


Here, 2 tables will be required

1. A(<u>a1</u>, a2)
2. BR(<u>b1</u>, b2, a1)

<u>NOTE.</u> Here, combined table will be drawn for the entity set B and relationship set R.

2.7.2. Case-02: For Binary Relationship With Cardinality Ratio 1,M:1

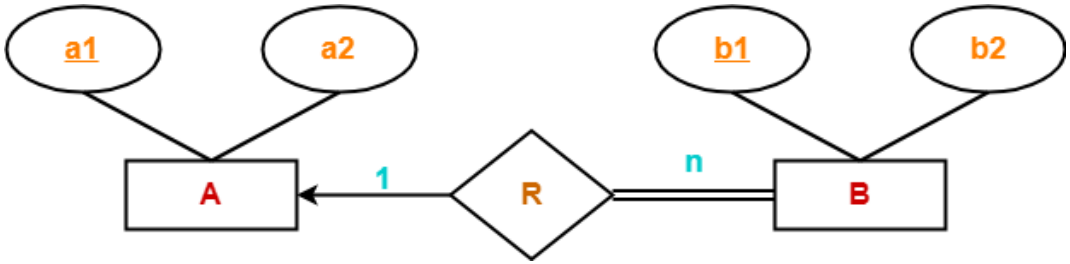


Here, 2 tables will be required

1. AR(<u>a1</u>, a2, b1)
2. B(<u>b1</u>, b2)

<u>NOTE.</u> Here, combined table will be drawn for the entity set A and relationship set R.

2.8. Rule-08: For Binary Relationship With Cardinality Ratio 1:0,n

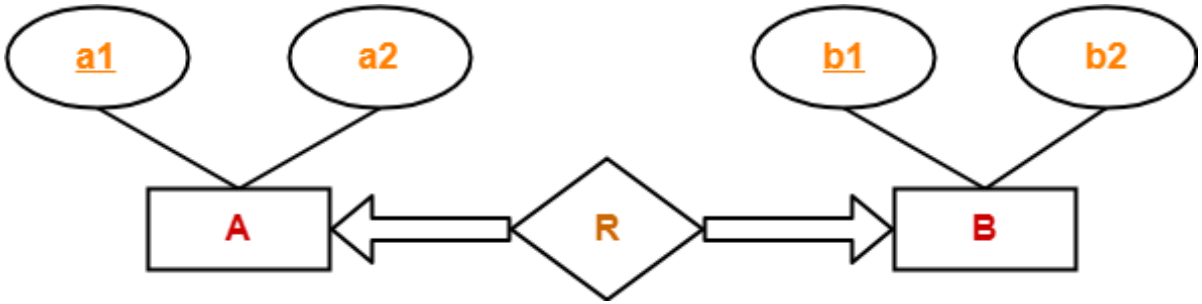


Then, **3 tables** will be required

1. A(a1, a2)
2. R(a1, b1)
3. B(b1, b2)

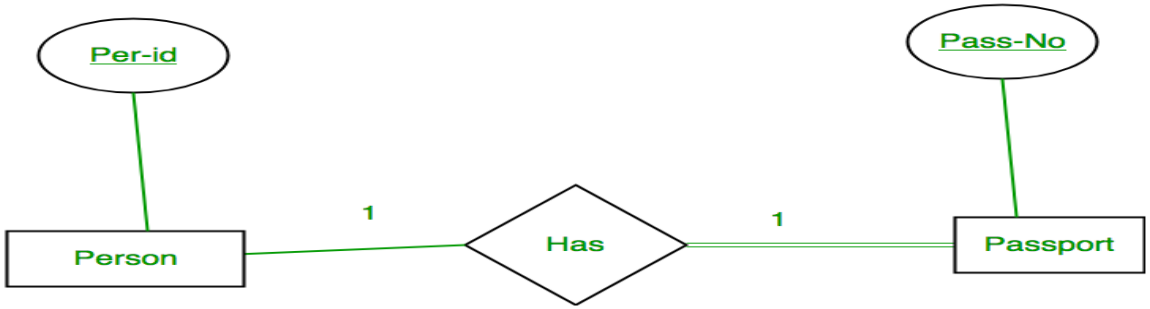
2.9. Rule-09: For Binary Relationship With Cardinality 1,1;1,1.

If there is a key constraint from both the sides of an entity set with total participation, then that binary relationship is represented using only single table.

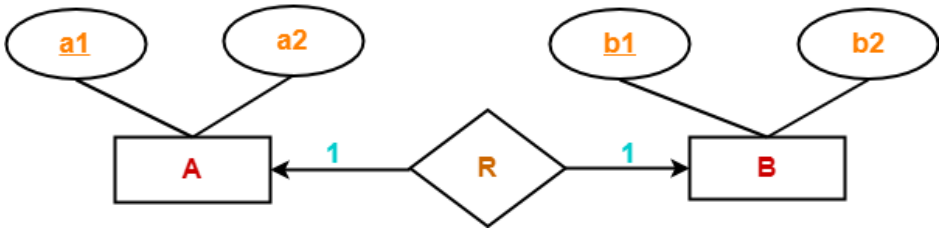


Here, Only one table is required

- ARB(a1, a2, b1, b2)



2.10. Rule-10: For Binary Relationships With Cardinality Ratio 1,1:0,1 or 0,1:1,1



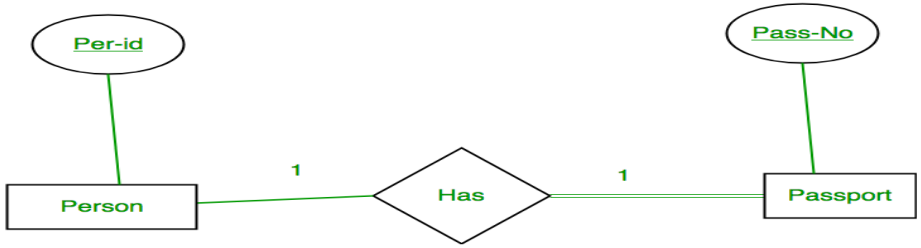
Here, **2 tables** will be required. Either combine 'R' with 'A' or 'B'

Way-01: for 1,1;0,1

1. AR(a1, a2, b1)
2. B(b1, b2)

Way-02: for 0,1;1,1

1. A(a1, a2)
2. BR(a1, b1, b2)

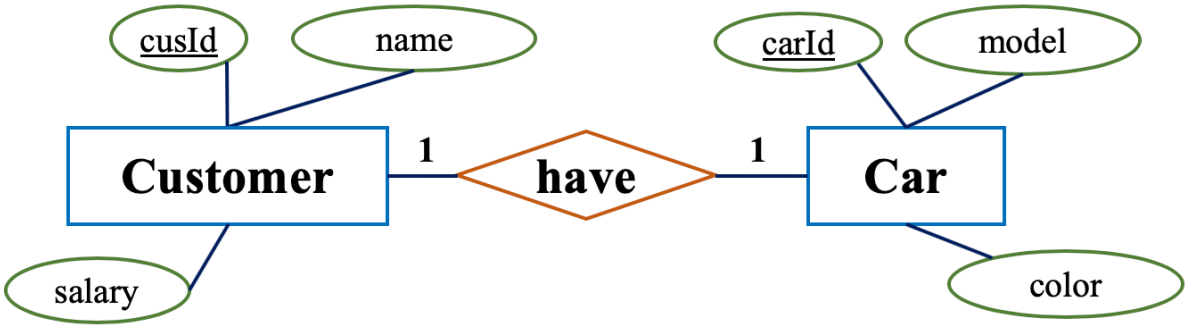


A person has 0 or 1 passport number and Passport is always owned by 1 person. So it is 1:1 cardinality with full participation constraint from Passport (1,1:0,1).

2.11. Rule-11: For Binary Relationships With Cardinality Ratio 0,1:0,1

Then, **3 tables** will be required

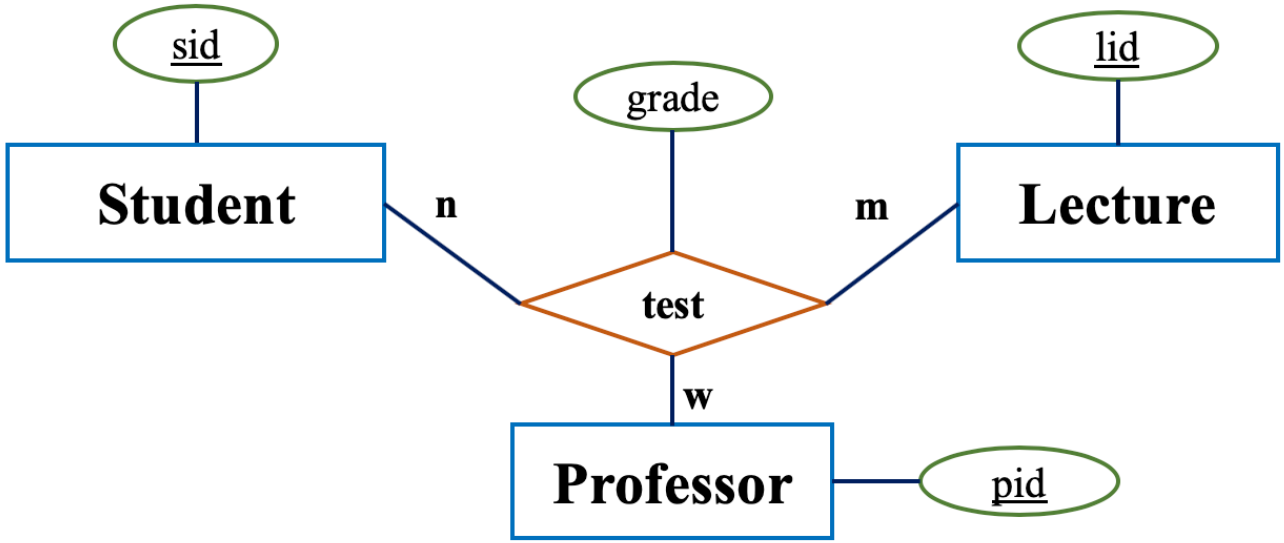
1. A(a1, a2)
2. R(a1, b1)
3. B(b1, b2)



Then, **3 tables** will be required

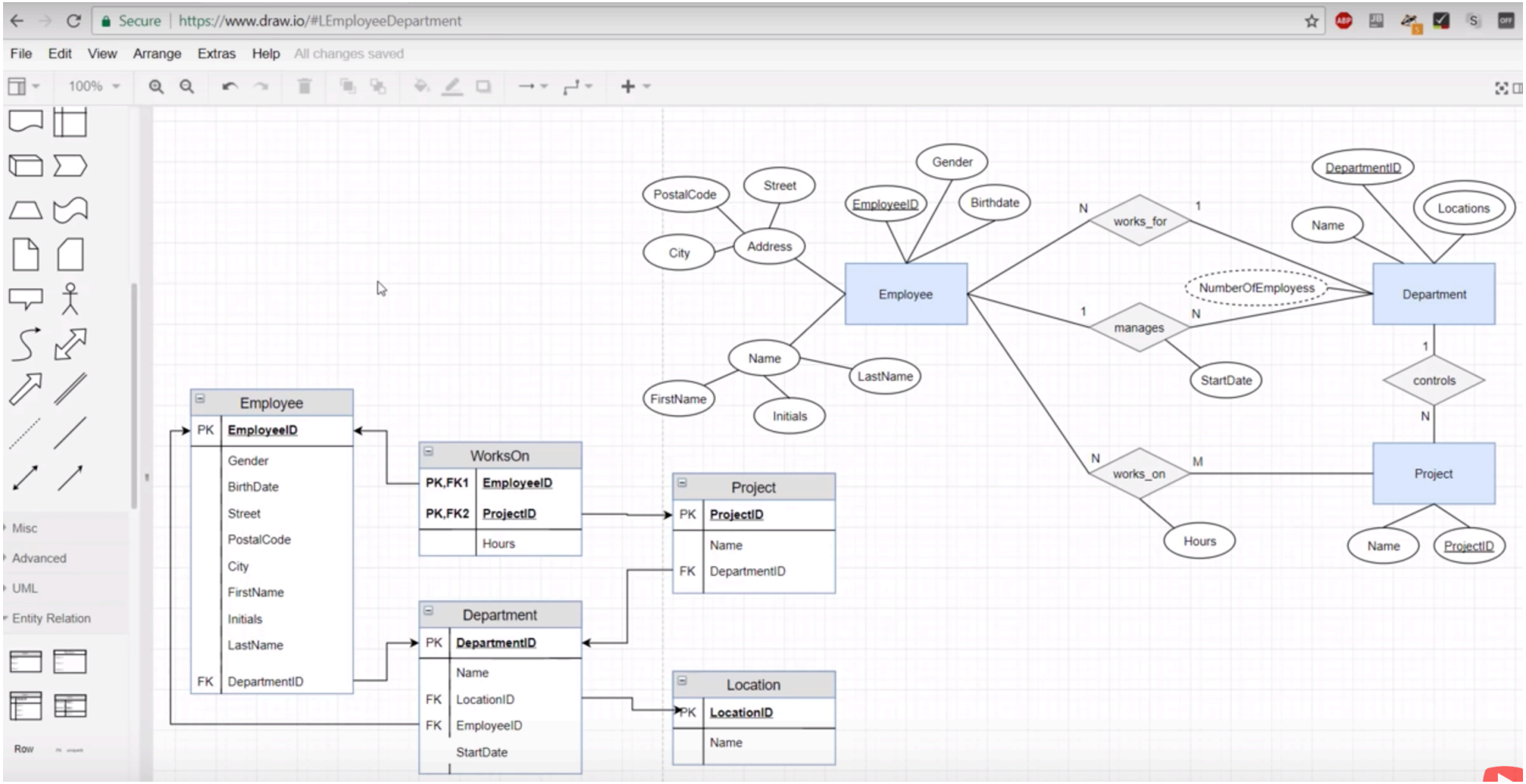
1. Customer(cusId, name, salary)
2. CusCar(cusId, carId)
3. Car(carId, model, color)

2.12. Ternary Relationship Example n:m:w



Test	sid	lid	pid	grade

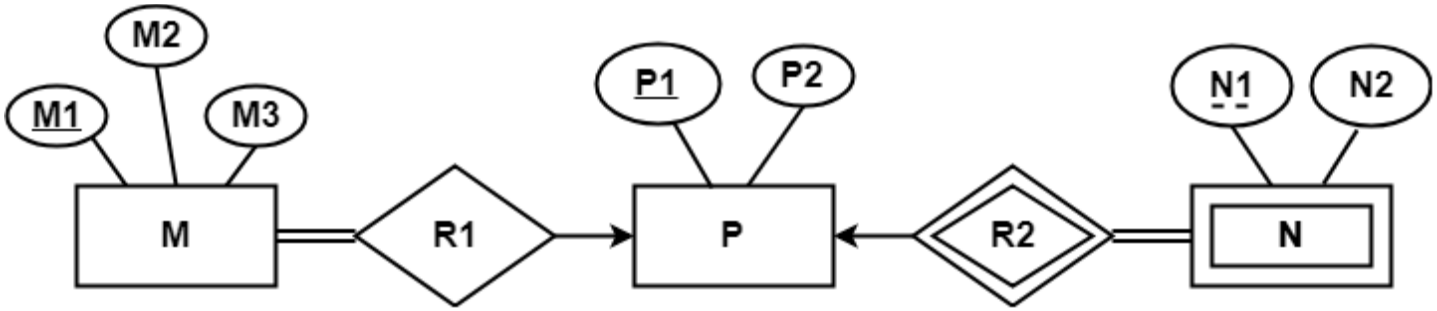
2.13. EXAMPLE OF CONVERT AN ER DIAGRAM TO THE RELATIONAL DATA MODEL.



3. Practice problem based on Converting ER Diagram to Tables

3.1. Problem-01:

Find the minimum number of tables required for the following ER diagram in relational model



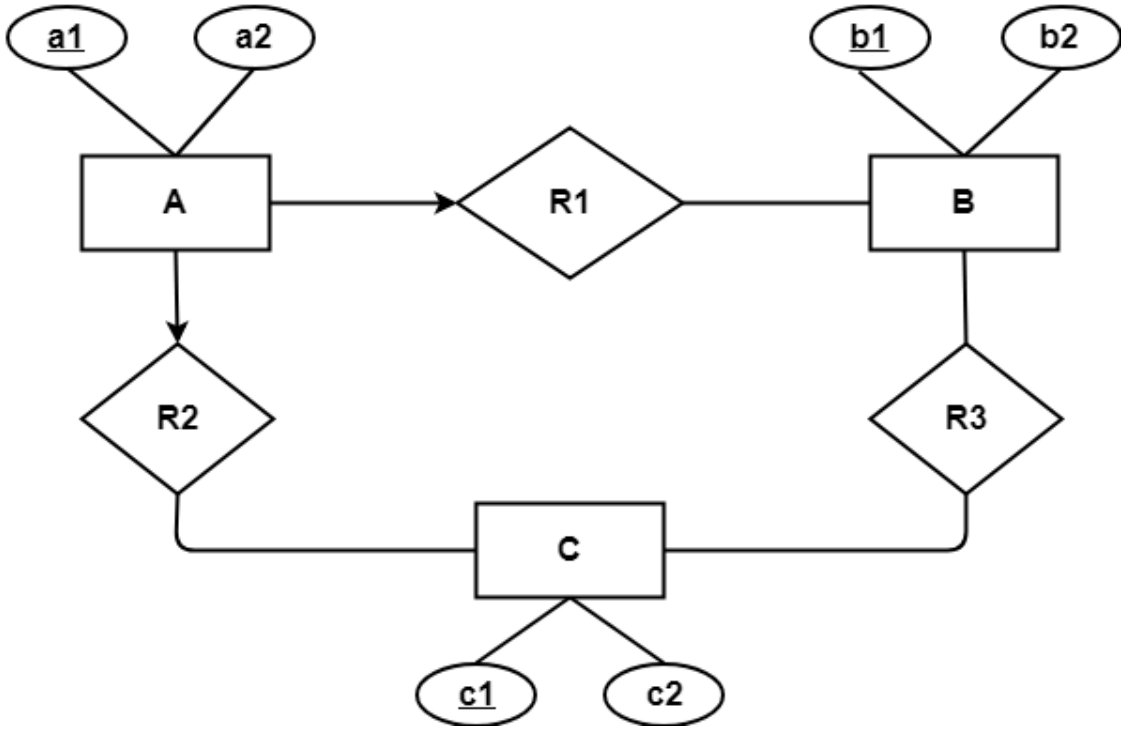
3.1.1. Solution

Applying the rules, minimum 3 tables will be required

- MR1(M1, M2, M3, P1)
- P(P1, P2)
- NR2(P1, N1, N2)

3.2. Problem-02:

Find the minimum number of tables required to represent the given ER diagram in relational model



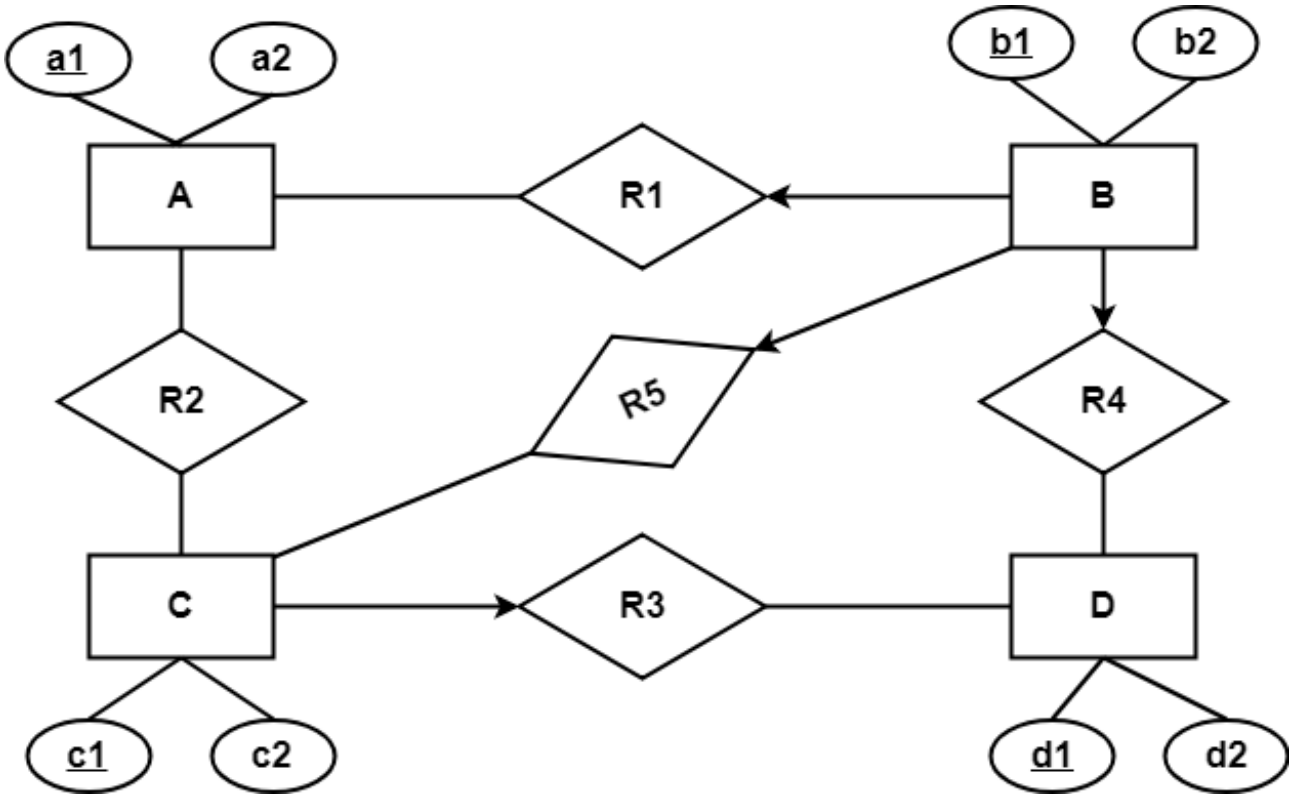
3.2.1. Solution

Applying the rules, minimum 4 tables will be required

- AR1R2(a1, a2, b1, c1)
- B(b1, b2)
- C(c1, c2)
- R3(b1, c1)

3.3. Problem-03:

Find the minimum number of tables required to represent the given ER diagram in relational model



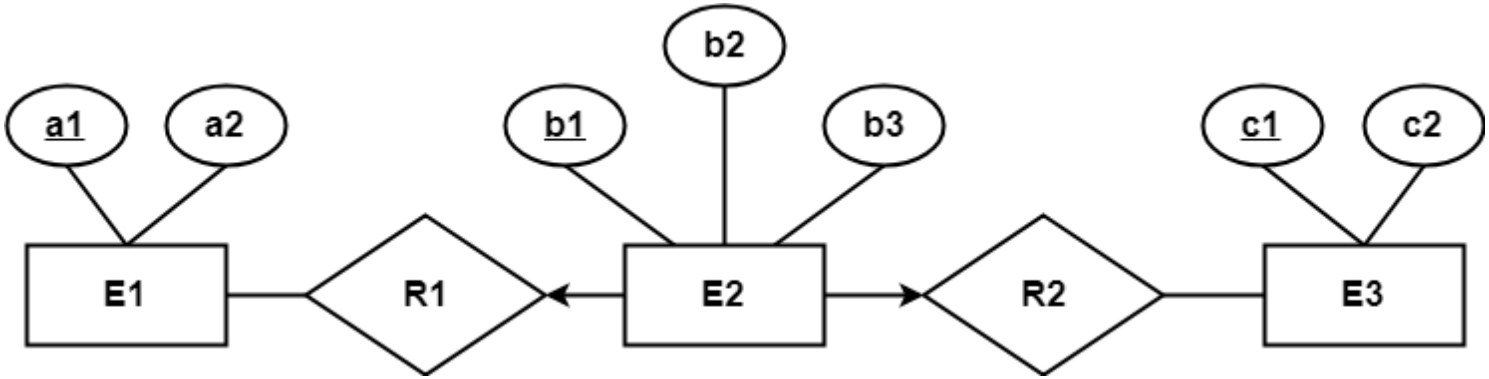
3.3.1. Solution

Applying the rules, minimum 5 tables will be required

- BR1R4R5(b1, b2, a1, c1, d1)
- A(a1, a2)
- R2(a1, c1)
- CR3(c1, c2, d1)
- D(d1, d2)

3.4. Problem-04:

Find the minimum number of tables required to represent the given ER diagram in relational model



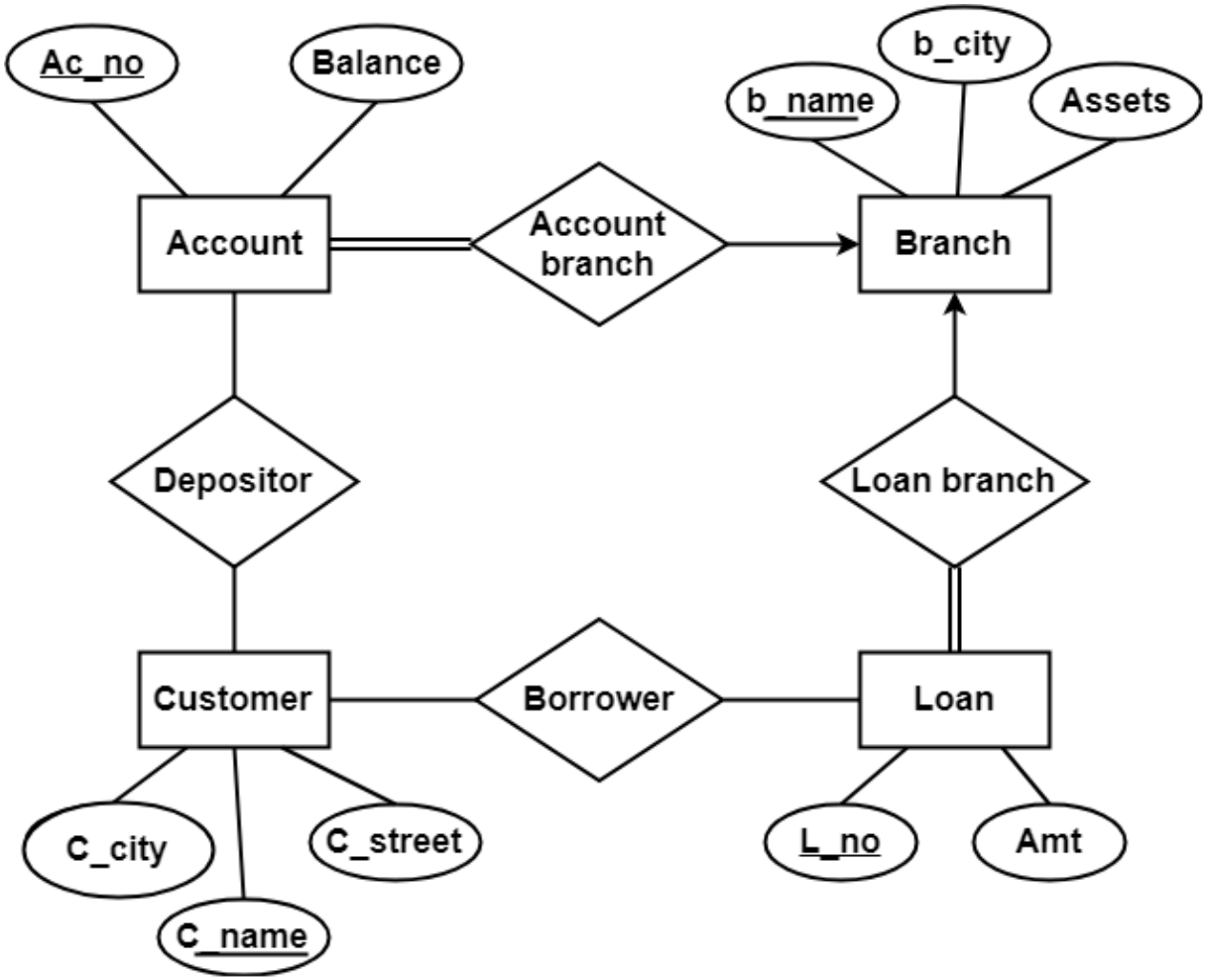
3.4.1. Solution

Applying the rules, minimum 3 tables will be required

- E1(a1, a2)
- E2R1R2(b1, b2, a1, c1, b3)
- E3(c1, c2)

3.5. PROBLEM-05:

Find the minimum number of tables required to represent the given ER diagram in relational model



3.5.1. SOLUTION

Applying the rules that we have learnt, minimum 6 tables will be required

- Account (Ac_no, Balance, b_name)
- Branch (b_name, b_city, Assets)
- Loan(L_no, Amt, b_name)
- Borrower(C_name, L_no)
- Customer(C_name, C_street, C_city)
- Depositor(C_name, Ac_no)