

Entity Relationship Model :- It defines data & relationships among data in a database planning.

Basic Components :-

- (i) Entity
- (ii) Attributes
- (iii) Relationship.

ER model defines conceptual or logical view of the database. It works around real world entities & relationships among them.

Through ER model we can represent database schema in graphical or pictorial form. It is the most widely used database model because it can be easily mapped into the relation.

It is used as a design plan by the database developer to implement database model in specific DBMS software.

① Entities :-

Entity is a real-world object which is distinguishable from other objects.

Entities have attributes that give identity to them.

An entity becomes table in a relational model.

In ER diagram it is denoted by rectangle.

A weak entity is an entity which cannot be uniquely identified by its own attributes & relies on the relationship with other entities. It is denoted by double rectangle.

Entity Set :-

Collection of similar type of entities that share the same attributes. for e.g. all the students of a class.

* Entity set must not be disjoint.

② Attributes :-

Attributes are used to describe the property of an entity. For each attribute there is a set of permitted values called Domain of that attribute.

It is denoted by ellipse in an ER diagram.

There are several types of Attributes :-

- ① Simple Attribute
- ② Key Attribute
- ③ Composite Attributes
- ④ Multi Value Attributes
- ⑤ Derived Attributes

③ Relation
It is a

Relation

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- ①
- ②
- ③
- ④

For

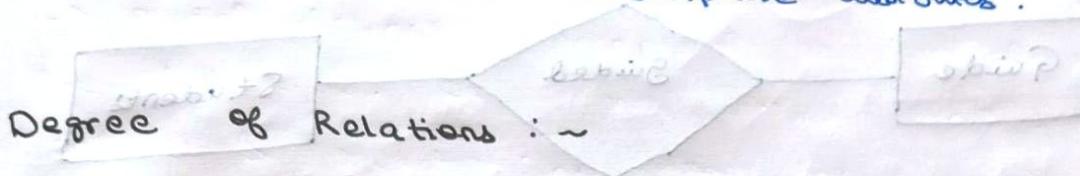
③ Relationship

It is represented by diamond shape.

Relationship set :-

Set of relationships of a similar type.

A relationship set can also have attributes. Such attributes are called descriptive attributes.



Degree of Relations :-

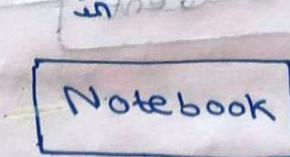
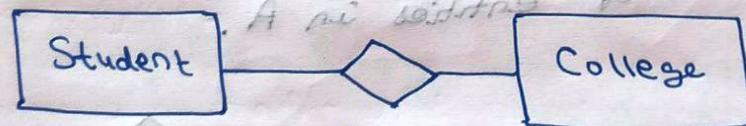
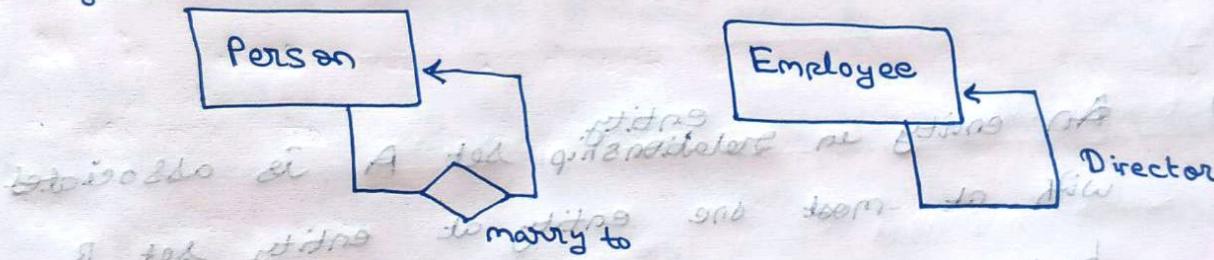
① Unary Relationship

② Binary

③ Ternary

④ n - Any Relationship

For e.g.



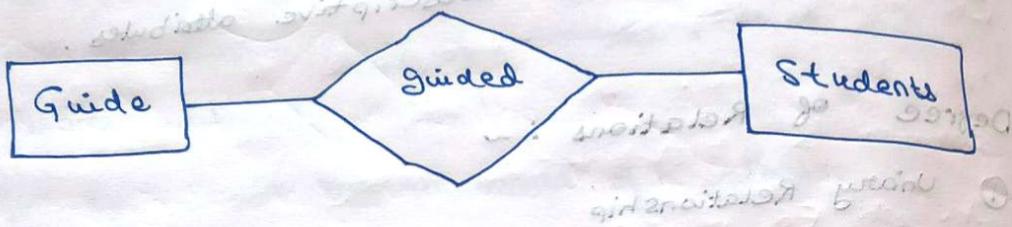
Mapping Cardinalities :- { 1 to 1, 1 to many
many to 1, many to many }

Suppose there are 2 participating entities A & B ;

①

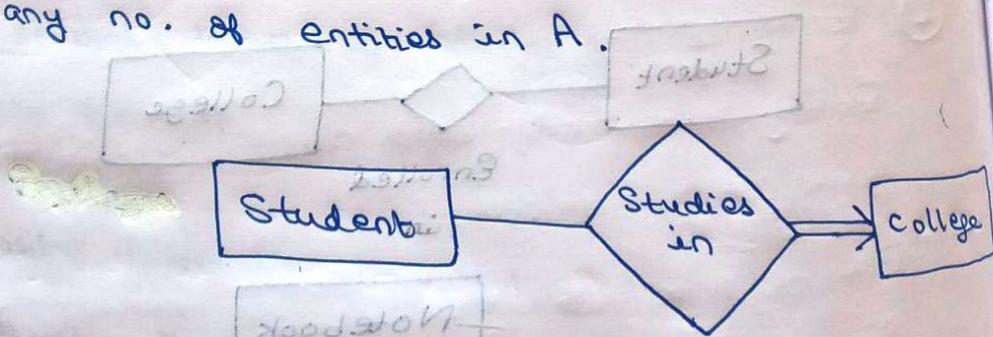


②



An entity in A is associated with any ~~most~~ of entities in B . An entity in B can however be associated with almost 1 entity set in A .

③ An entity in ~~entity~~ set A is associated with at most one entity in entity set B however an Entity in B can be associated with any no. of entities in A .



④



Cardinality

Customer

ER Diagram

- ① use
- ② if use
- ③ with Ch

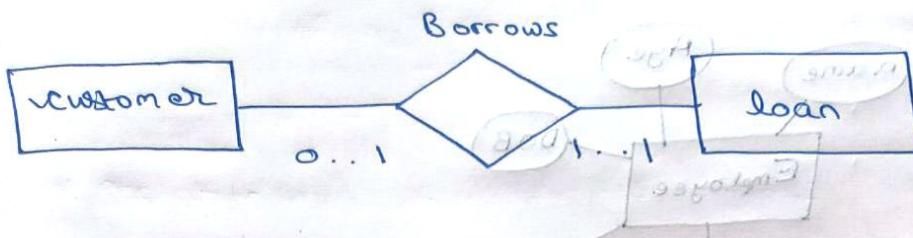
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Cardinality limit of relationship set :-



ER Diagram Design Issues :-

- ① use of Entity vs Attributes
- ② use of Entity vs Relationship set
- ③ choosing Binary vs n-Ary Relationship

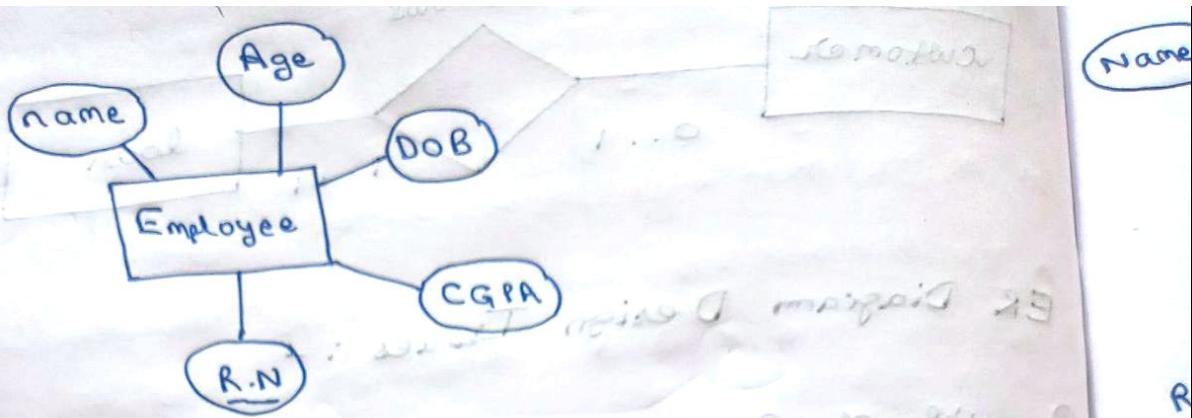
A common mistake done by the database designer is to use primary key of an entity set or an attribute into another primary key of other entity set.

Another mistake is to designate the primary key attribute of the related entity set as attribute of the Relationship set.

Converting ER Diagram into Relation :-

Table

RULE 1) A strong entity set with only simple attributes will require only one table in the relational model.



- > Attributes of the table will be the attributes of the entity.
- > Primary key of the table will be the key attribute of the entity set.

R.N	Name	Age	DOB	CGPA

RULE 2)

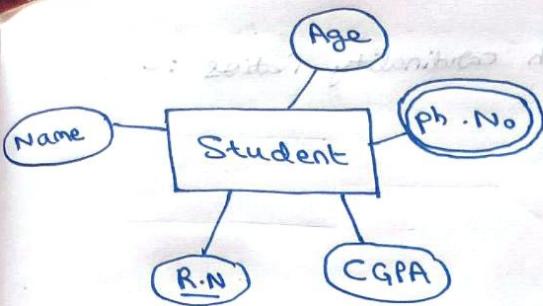
Strong Entity set with Composite attributes :-

- Such ER Model require only table in relational model.
- While conversion only simple attributes are considered, not the composite attributes.

RULE 3) Strong Entity set with Multivalued attributes :-

Such ER Model require two tables in relational model.

One model will include all the simple keys & the second table will contain the primary key & multi-valued attributes.



① Student (RN, Name, Age, CGPA)

RN	Name	Age	CGPA
1	A	20	8.5
2	B	21	8.2

② Student (RN, Ph. N.)

RN.	Ph. No.
1	1234567890

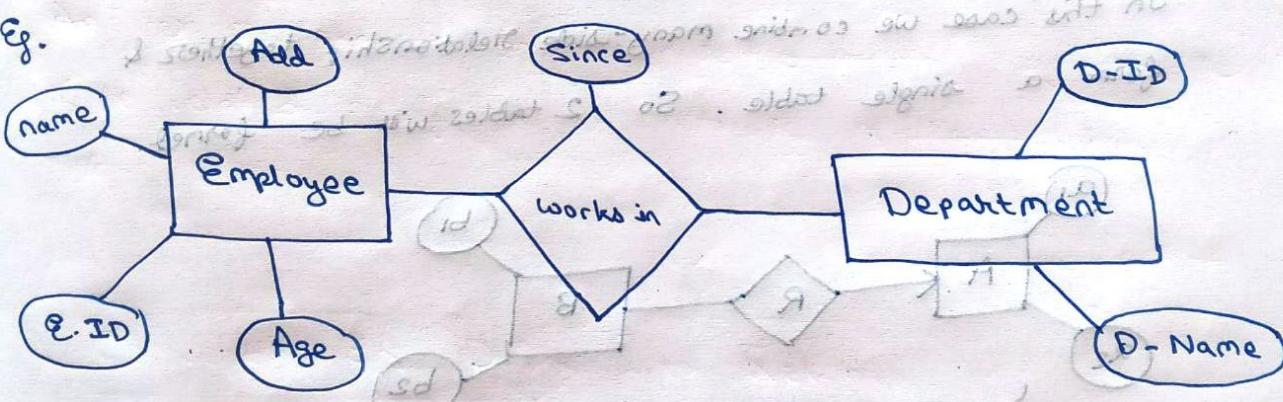
RULE 4) Converting Relationship set into a table

Relationship set require 1 table in the Relational model.

The attributes of the table will be :

- i) Primary key attributes of the participating entities.
- ii) Its own descriptive attributes if any.
- iii) The set of non-descriptive attributes will be the primary key of the relation.

Eg.



① Employee

E-ID	Name	Add	Age
1	A	123 Main St	20

② Department

D-ID	D-Name
1	IT

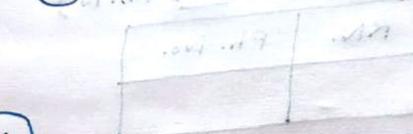
③ works-in (E-ID, D-ID, Since)

E-ID	D-ID	Since
1	1	2023-01-01

RULE 5) for Binary Relationship with cardinality Ratios :-

- ① $m:n$
- ② $n:1$
- ③ $1:1$
- ④ $1:n$

4. $1:n$ many to one



case 1

attr. a1

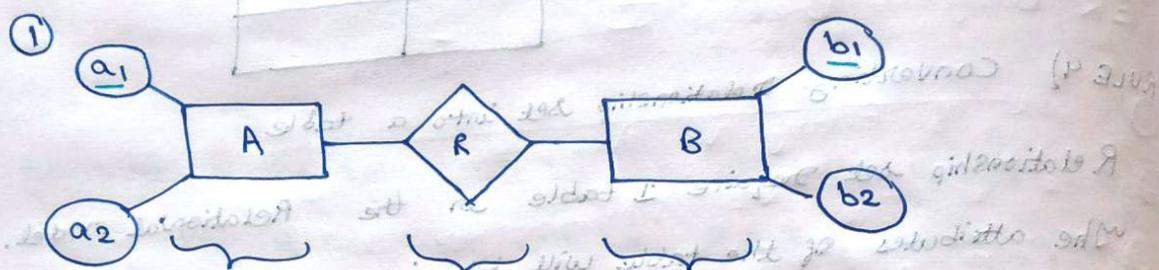
attr. b1

attr. b2

attr. a2

attr. b1

attr. b2

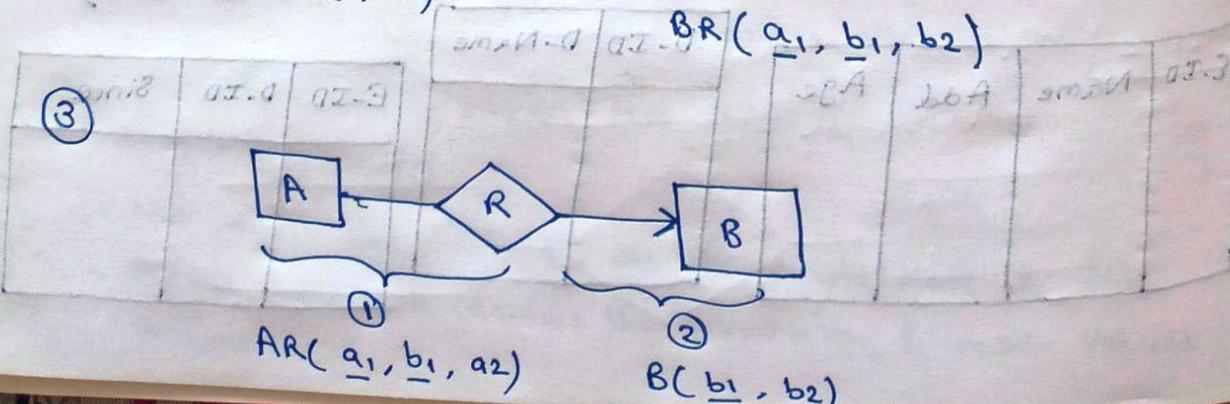
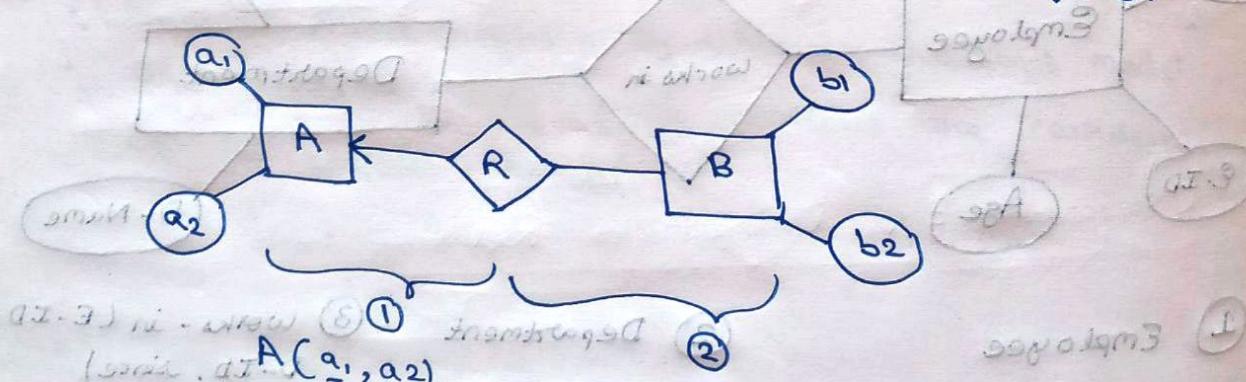


In many-to-many relationships 3 tables will be required

$\Rightarrow A(a_1, a_2)$ and $R(a_1, b_1)$ and $B(b_1, b_2)$

2

In this case we combine many-side relationship together & form a single table. So 2 tables will be formed.



In this case we will again use the 2 tables for ER model.

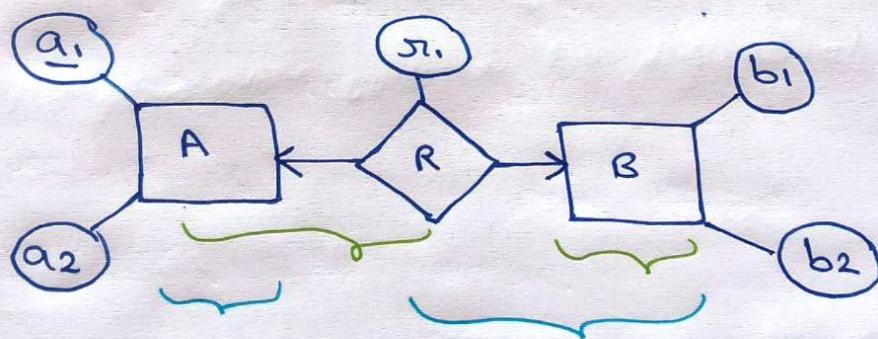
- ④ 2 tables will be required for this ER diagram.
We can either combine R with A or
R with B.

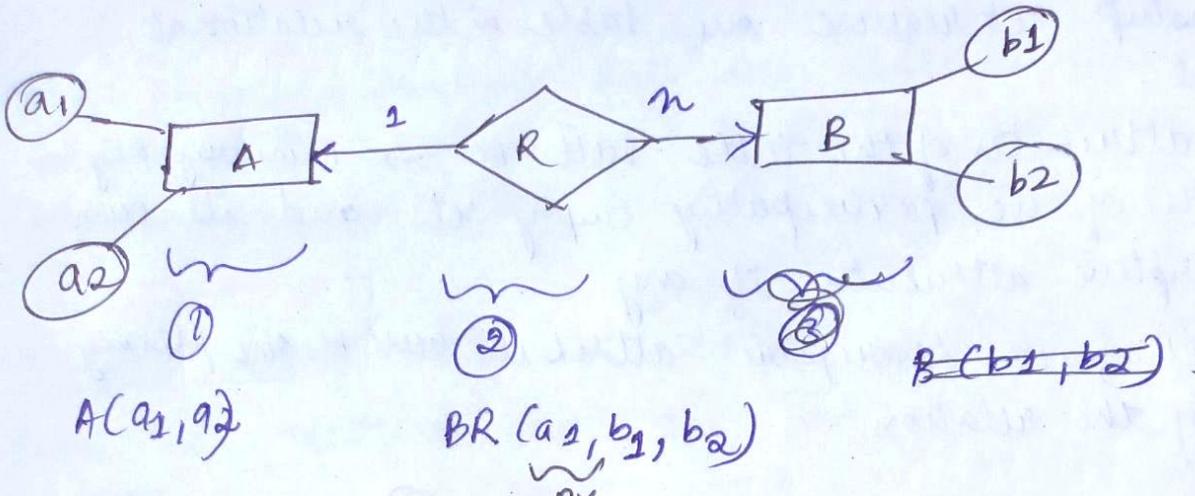
Case I) Combining R with A.

- i) AR ($\underline{a_1}, \underline{b_1}, a_2, g_{r1}$)
- ii) B ($\underline{b_1}, b_2$)

Case II) Combining R with B.

- i) BR ($\underline{a_1}, \underline{b_1}, b_2, g_{r1}$)
- ii) A ($\underline{a_1}, a_2$)





* m:1 (Many-to-one)

In this case, again we will use 2 tables to represent ER diagram. 1st table will contain first relation

* 1:1 (One-to-one)

Two tables will be required for this ER diagram, we can combine either R with A or R with B.

CASE 1: combine R with A.

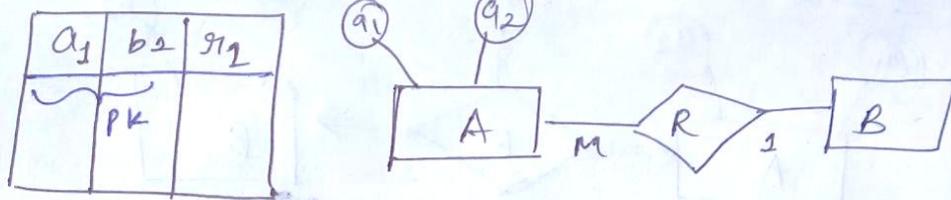
① $AR(a_1, a_2, b_1, a_1)$ ② $B(b_1, b_2)$
 PK: $\{a_1, a_2\}$

CASE 2: combine R with B.

① $BR(a_1, b_1, b_2, a_1)$
 ② $A(a_1, a_2)$

Converting ER diagram into Relational Model:-

①

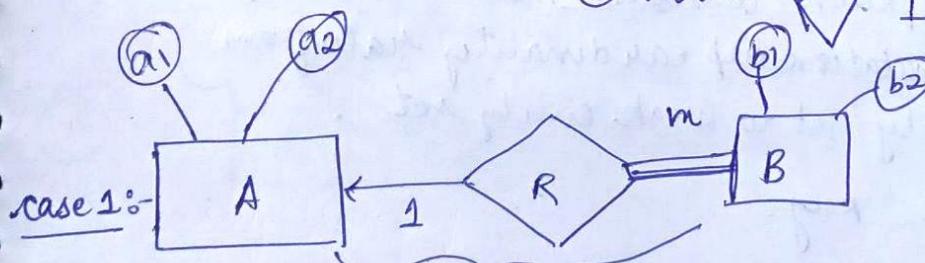


Rule VI:- For binary relations with both cardinality constraints and participation constraints.

Cardinality constraints are handled as discussed in rule IV.

Total participation constraint means foreign key cannot be null.

- ① Total
- ② Partial

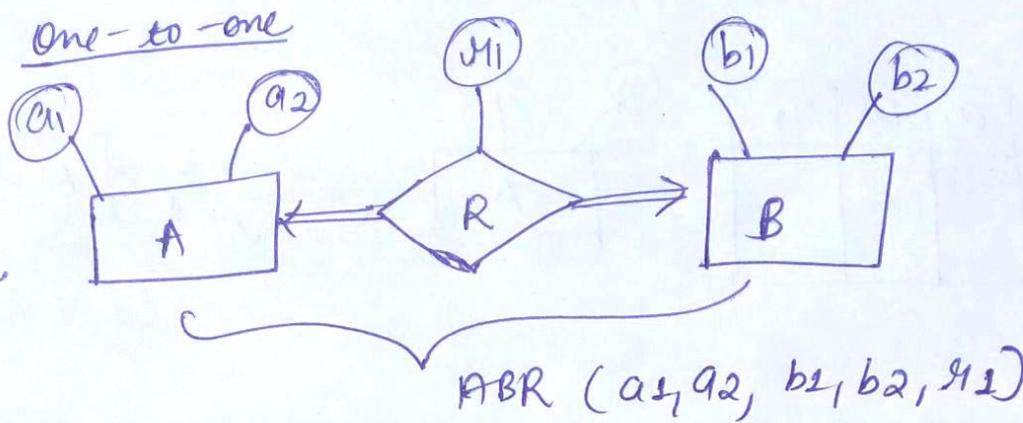


b1	b2	g1	a1
			PK

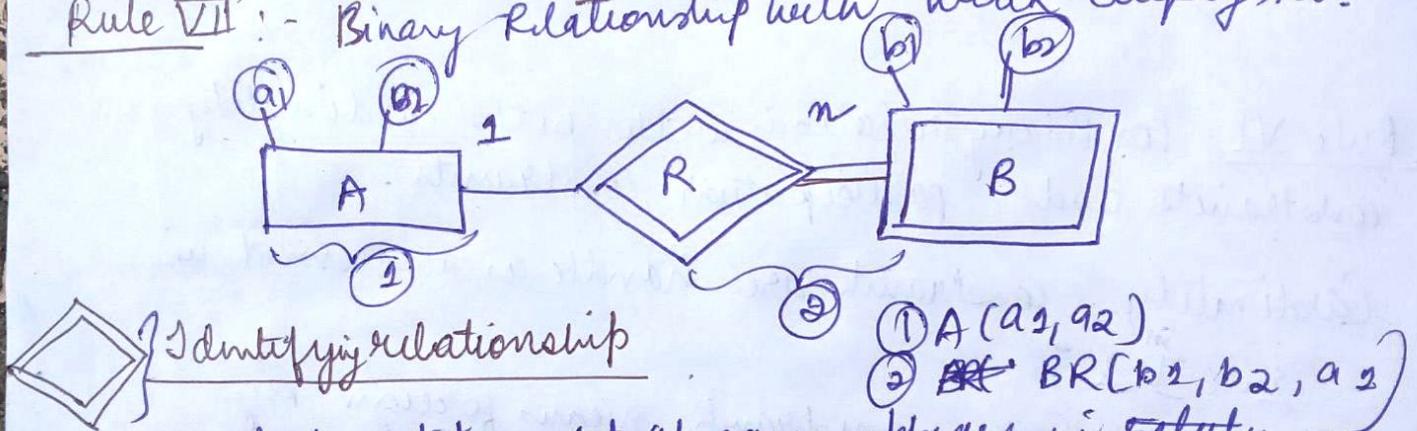
BRC (b1, b2, g1, a1, FK)

∴ hence Foreign key A1 has acquired not null, means that it cannot be null.

case 2:- Total participation from both side .



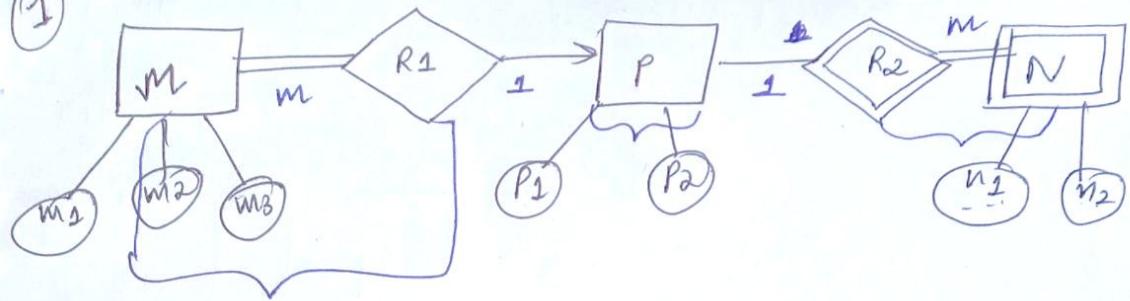
Rule VII :- Binary Relationship with weak empty set.



Weak entity set always appears in ~~total~~ association with identifying relationship with total participation constraints. There is always one-to-many ~~relationship~~ cardinality ratio from identifying entity set to weak entity set .

K } Partial key.

①



Mui. no. of tables:- 3

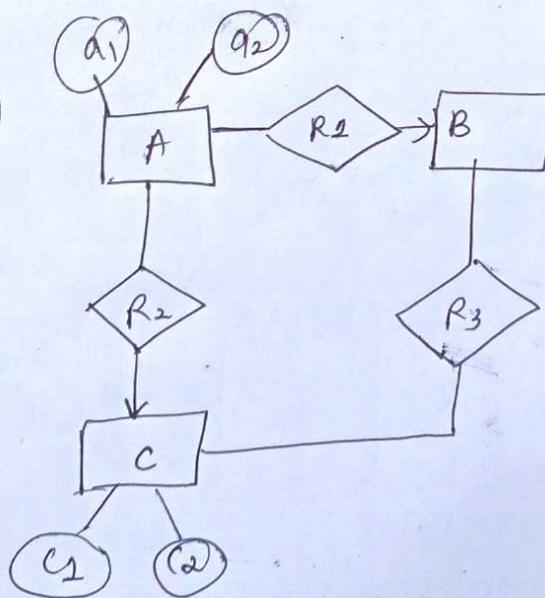
m ₁	m ₂	m ₃	p ₁	

MR₁(m₁, m₂, m₃, R₁, p₁)

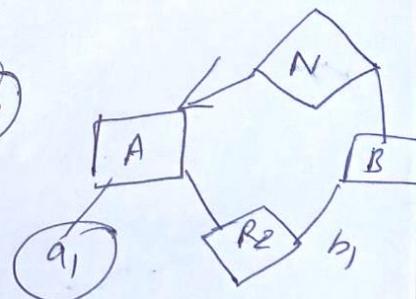
n ₁	n ₂	m ₂	p ₁

NR₂(n₁, n₂, R₂, p₁)

②



③



Keys in DBMS:-

2) C

- 1) Super key
- 2) Candidate key (minimal super key)
- 3) Primary key
- 4) Alternate key
- 5) Foreign key
- 6) Composite key

- i) A key is an attribute or set of attributes that is uniquely used to identify a record in a relation.
- ii) It is also used to establish and identify relationship between tables.

1) Super key :-

- It is a combination of all possible attributes that can uniquely identify records in a given relation.
- It is a super-set of candidate key.
- A relation can have several number of super keys.
- A super key may have some additional attributes that are not needed for unique identity.

2) Candidate key :~

- Candidate key is an attribute or set of attributes which can uniquely identify a record or a tuple.
- A C.K is a minimal Super key or Super key with no redundant attributes.
- A Super key with minimum no. of attributes to uniquely identify a record.
- Candidate keys are defined as a distinct set of attributes from which primary key can be selected.
- Candidate keys are not allowed to have null values.
for eg. {E - Num}
{E - Pan No.}
{E - Aadhar}

3) Primary key :~

- It is one of the candidate key chosen by the database designer to uniquely identify a record in the relation.
 - The value in the primary key must be unique, it must never be changed, it must be assigned when inserting a record.
 - In a relation, only one primary key must be allowed.
 - It cannot be null.
- for eg. {E, ID}

Exter

- (1) Geo
- (2) Spe
- (3) A
- (1)

4) Alternate key:

- Out of all candidate keys only one is selected as primary key; remaining keys are known as alternate keys.

for e.g. {E-PAN} , {E-Aadhar}

5) Foreign key:

- It is used to maintain referential integrity constraint.
- Foreign key is a key to link or join two tables together.
- Foreign key is an attribute or a set of attributes in one table that refers to the primary key in another table.
- Foreign key is used to maintain or ensure referential integrity of the data so that tables in relation be linked or updated.

Foreign key of another table
Referenced | Master Table | Primary | Parent Table

- Foreign key can take only those values which are present in the primary key of the reference table.
- Foreign key can have a name other than the primary key.
- There is no restriction on F.K to be unique.

Extended ER Features :-

- ① Generalization
 - ② Specialization
 - ③ Aggregation
- ① It is a process of extracting common properties from a set of entities & creating a generalized entity from it.
It is a bottom up approach where sub-classes are combined to make a super class.
- ② It is opposite of generalisation. It is a top-down approach where a higher level entity is divided or specialised into two or more lower level entities.
It is used to identify the sub-set of an entity set that share some distinguishable characteristics.
It can be repeatedly applied to refine the design of schema.