

## E-R diagram

- Introduced by Dr. Peter Chen in 1976
- Non-technical method works on conceptual level
- consists of collection of basic objects called entities and relationship among objects and properties which defines their properties.
- It is a visual representation of data that describe how data is related to each other.
- non-technical person can easily understand.

Entity → An entity is a thing or object in the real world that is distinguishable from other objects on their values of the attributes it possesses.

### Types of Entities

tangible      intangible

↓  
which physically  
exist in real  
world

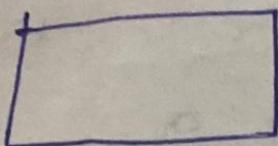
e.g. - Car, Pen,  
bank locker

entities which  
exists logically  
e.g. - Account

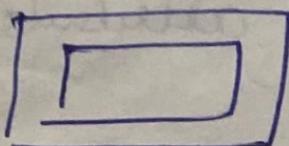
Entity set → collection of similar type of object

collection / set of same type of entities  
i.e. that share same properties or  
attributes called entity set.

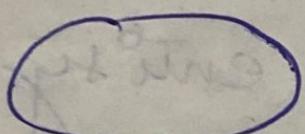
## Basic Terminology of ER Model



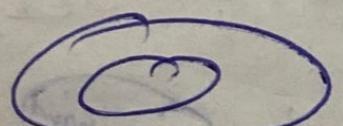
→ entity or strong entity



→ weak entity



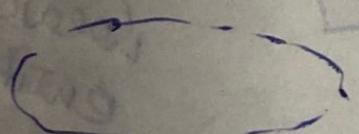
→ attribute



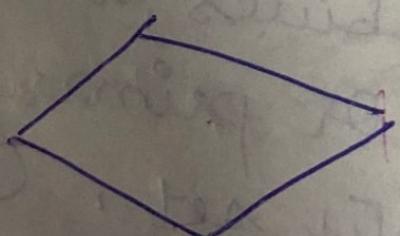
Multivalued  
weak attribute



→ composite attribute



→ derived attribute



→ Relationship

Attributes → Attributes are the properties of an entity, which describe characteristics of an entity.

### Types of Attribute

#### (i) Simple and Composite attributes

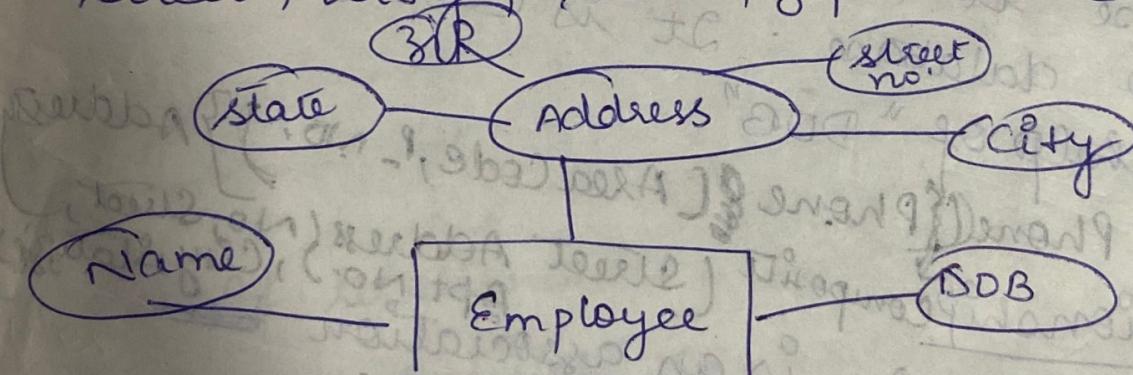
→ A simple attribute is just an attribute that cannot be divide into parts.

For ex → name, age, salary etc.

#### (ii) Composite attribute

It is an attribute than can be subdivided into other attributes.

For ex → Address can be subdivided into street, city, state, zip code etc.



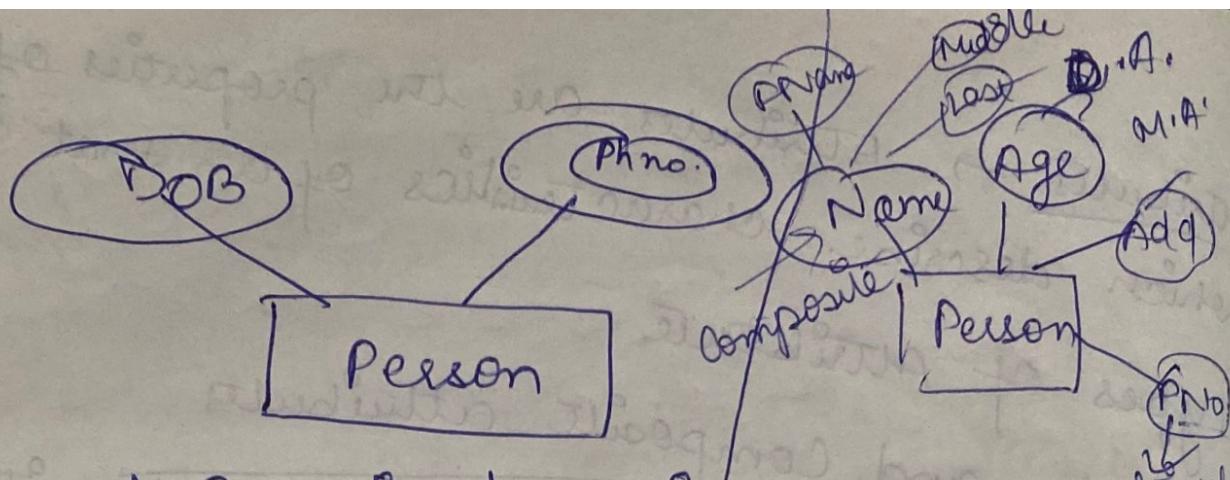
#### (iii) Single value & Multivalued Attributes

→ Single value attribute can have only a single value.

For ex → A person can have only one "DOB" or "age".  
A student can have only one "roll no."

Multivalued → It can have multiple values.

For ex → A person may have multiple phone numbers.



### (iii) Stored & Derived Attributes

Stored attributes are those attributes, which are physically stored into the database.

→ Derived attributes of those attributes which are not physically stored into the database.

For ex → Age is derived attribute, because it is not physically stored in the database. It is calculated with the help of "DOB".

A key is a set of one or more attributes which is used to uniquely identify of data within a table.

There are two rules to form a key

- 1) Two data should not be same.
- 2) Data should not be null to which we are going to select a key.

### Types of Keys

- (i) Superkey → It is defined as a set of attributes within a table that can uniquely identify each record within a table.
- ⇒ Super key is a superset of Candidate key.

student	st-id	sName	phone	age
	1	Aichil	X	19
	2	Aichil	Y	20
	3	Bhanu	Z	18
	4	Priya	A	18

Super key  $\rightarrow \{st\_id\}, \{st\_id, s\_name\}$   
 $\{phone\_no.\} \text{ etc.}$

### Candidate key

$\Rightarrow$  minimum set of attributes used to uniquely differentiate record in the table.

Candidate key is same as  
key attribute

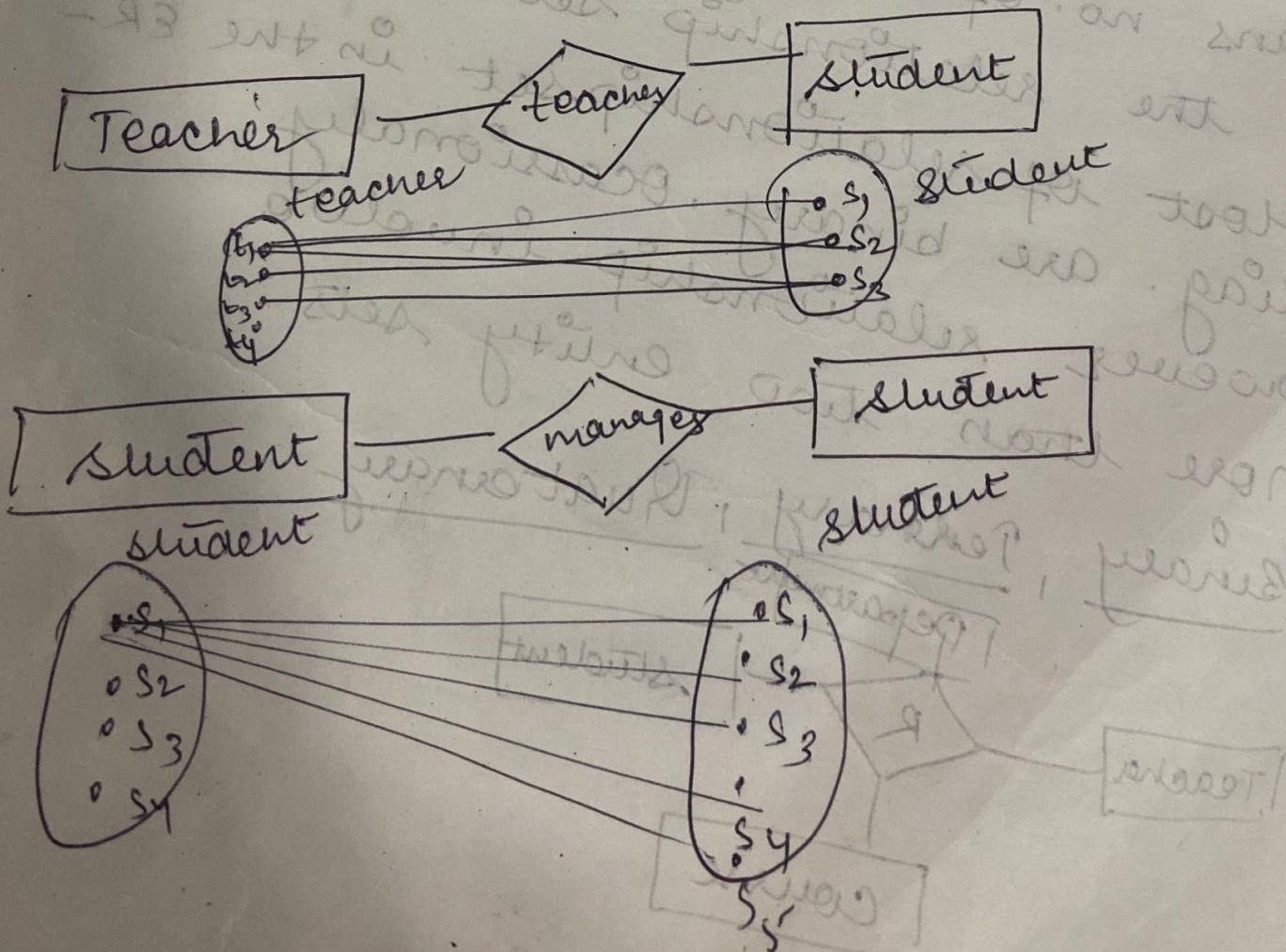
Primary key →  
chose any one key from candidate  
key is known as primary key.  
and rest of the keys in candidate  
key are alternate key.

⇒ For any relation, one Primary  
key is allowed.

## Relationship and Relationship set

- A relationship is an association among several entities of same or different entity set
- A relationship set is a set of relations of the same type. In an er-diag. by using diamond it is a mathematical relation on  $n \geq 2$  (possibly on distinct) entity sets.

Relationship can be binary, ternary and n-ary.



→ Every relationship type has three components -

(i) Name      (ii) Degree      (iii) Cardinality

Every relationship  
has unique name

ratio / Participation

constraints

of relationship

to single set of

entity set participate

in one set of degree

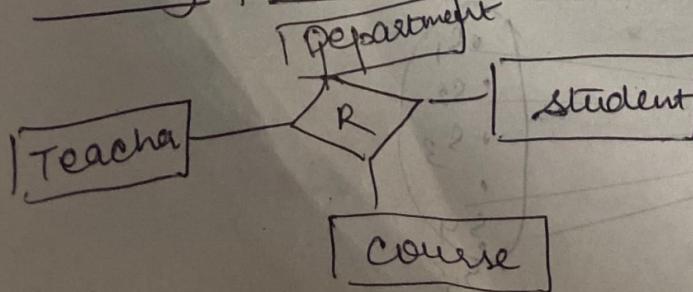
one set of

Degree of a relationship

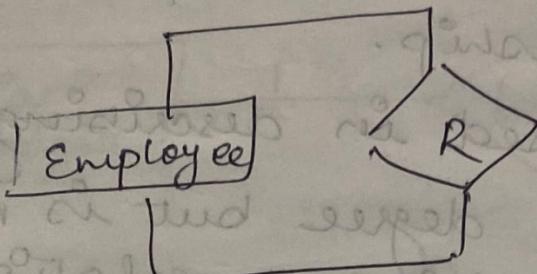
means no. of entity sets associated  
in the relationship set.

→ Most of relationships in the ER-  
diag. are binary. Occasionally  
however relationship involve  
more than two entity sets.

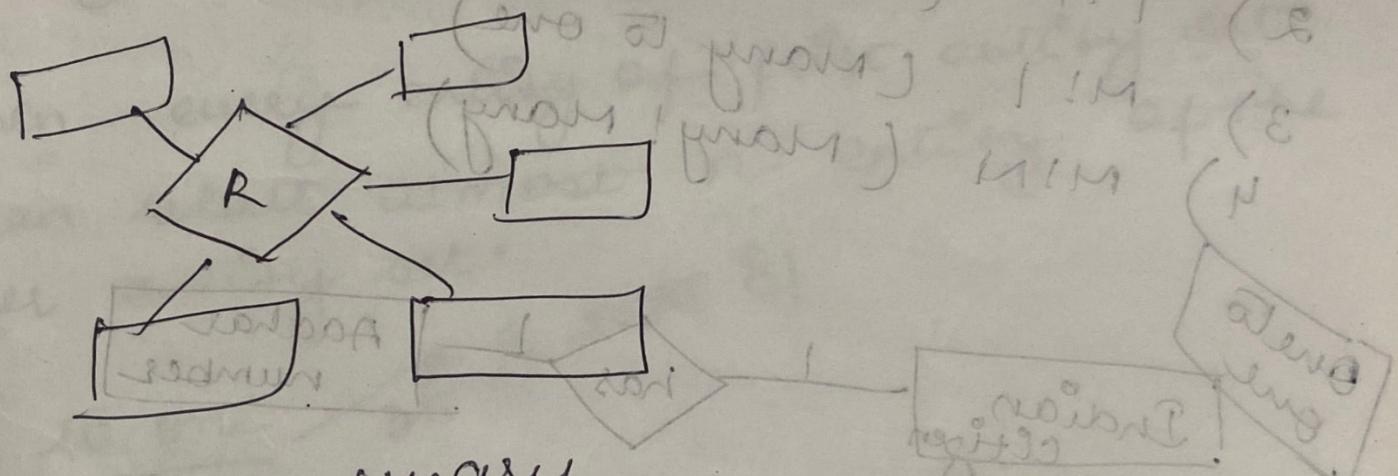
Binary, Ternary, Quaternary



## Unary relationship



## n-Ary



Min degree  $\rightarrow$  unary  
Max degree  $\rightarrow$  n-Ary

Mapping Cardinality / Cardinality ratio

Express the no. of entities of one entity to which other entity can be related via a relationship.

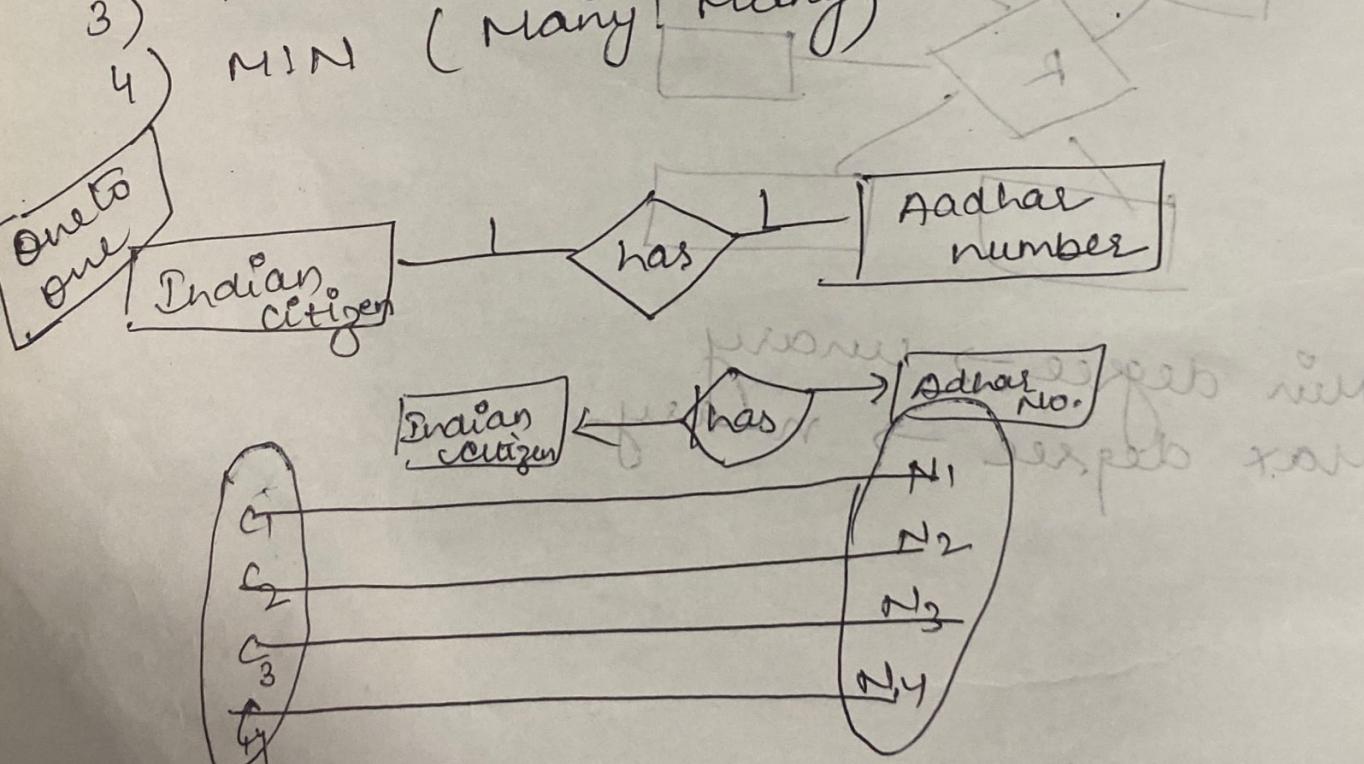
→ It can be used in describing relationship set of any degree but is most useful in binary relationship.

1) 1:1 (one to one)

2) 1:N (one to many)

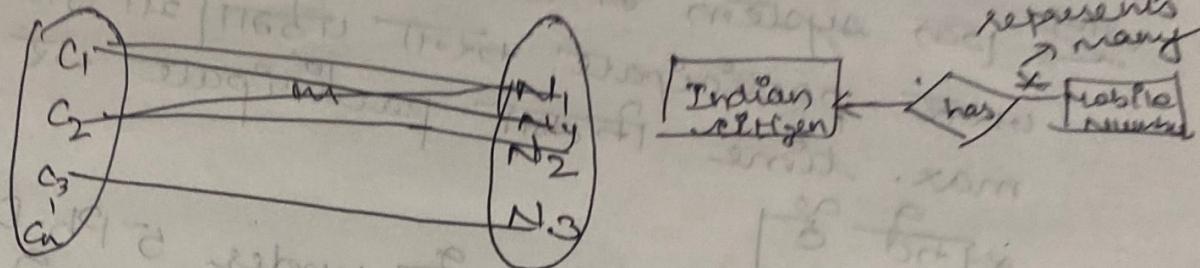
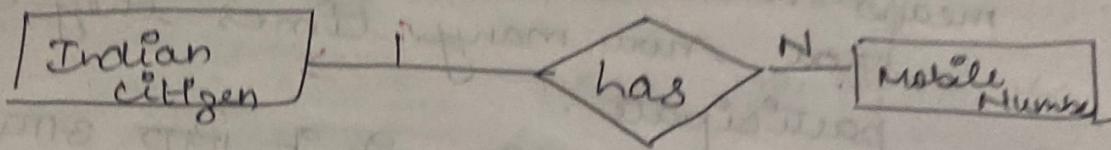
3) M:1 (many to one)

4) M:N (many to many)



When each entity in entity set can take part only almost once to other entity of other entity set and vice versa.

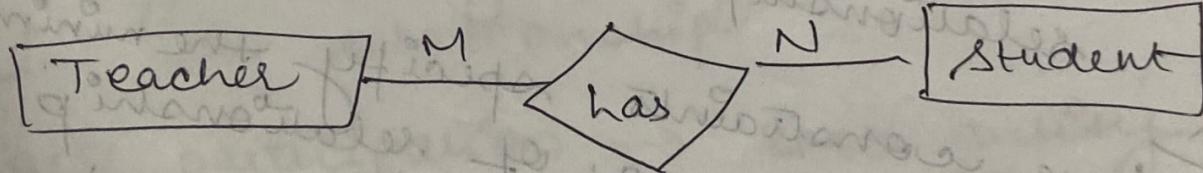
## One to Many



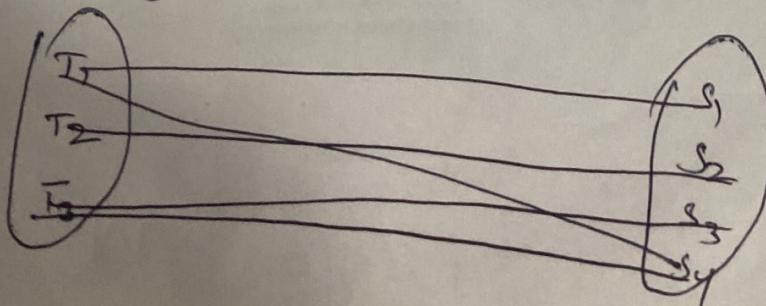
when every entity of first entity set can relate almost n entity of the other entity set.

## Many to one

## many to Many



when entities in all entity sets can take place more than once to other entity set.



## Participation constraint

means we can put restriction on entity  
that how many times they can  
participate.

participate.

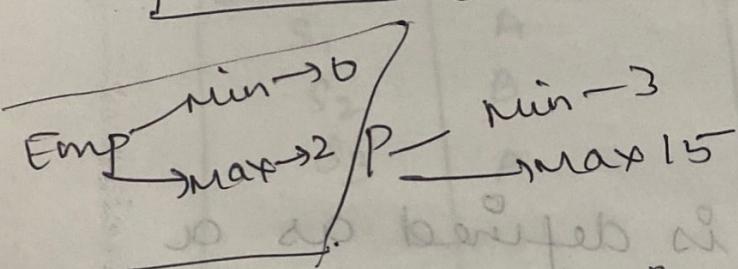
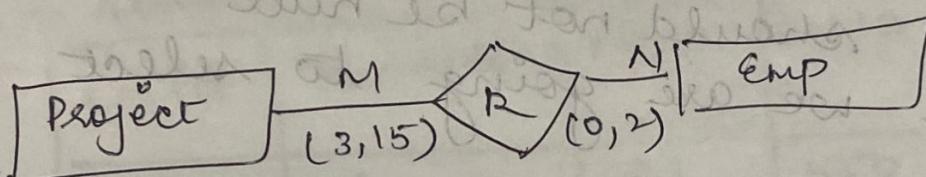
why  $\rightarrow$  the system में बने रहने के लिए आपकी  
 जरूरी participate + $\rightarrow$  पड़ेगा। या आप  
 max. time के लिए participate + $\rightarrow$   
 सकते हो।

5 Ph.D.

defn These constraints specify the minimum and maximum no. of relationships instance that each entity can/must participate in.

Max. Cardinality → It defines the max. no. of times an entity occurrence participating in a relationship

Min. Cardinality → min. no. of times

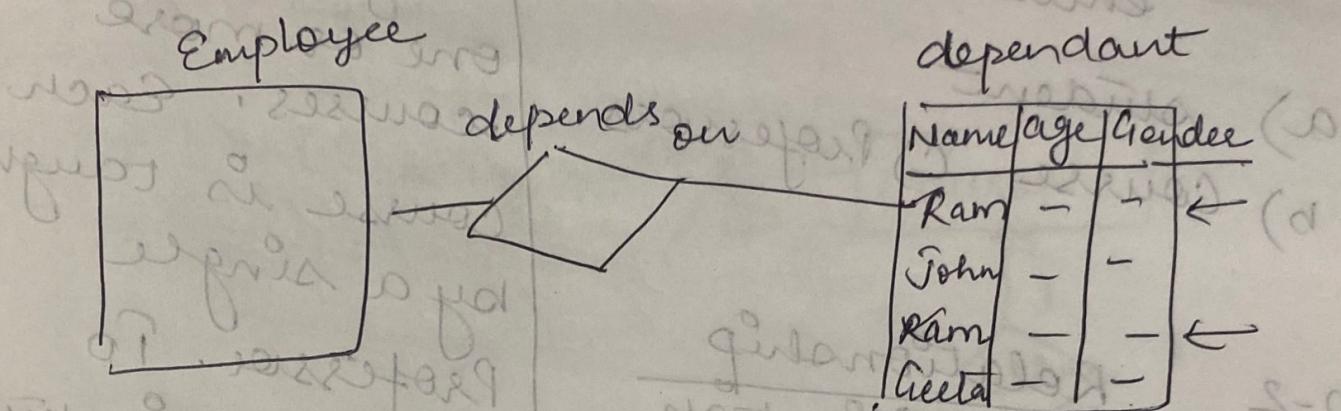


→ Partial participation → The entity in the entity set may or may not participate in the relationship.

Total participation → each entity in the entity set must participate in the relationship.

Total participation is shown by double line in ER diagram.

Weak entity → It is an entity type which do not have a key attribute



company will take care of emp  
dependents of employee.

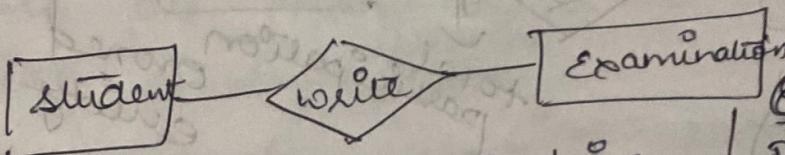
Two employees has same name  
we identify it with the help of  
identifying relationship through strong entity.

The existence of a weak entity set depends on the existence of a identifying entity set.

→ The P.K. of a weak entity set is formed by the P.K. of the strong entity set on which the weak entity set exists.

dependent

## Q-1 Students write Examination



Construction of ER diag

- ① Entity Identification  
we have three entities

- a) student      b) Course      c) Professors

### Step-2 Relationship Identification

we have two relationships  
→ student is assigned a course.

→ Professor delivers a course.

### Step-3 Cardinality Identification

→ A student can be assigned multiple courses.

→ A professor can deliver only one course.

In a university a student enrolls in courses. A student must be assigned to at least one or more courses. Each course is taught by a single Professor. To maintain instructional quality, a professor can deliver only one course.

Entity

student

Professor

course

Step -5

Create the ERD

Primary key  
student\_id

Emp\_id

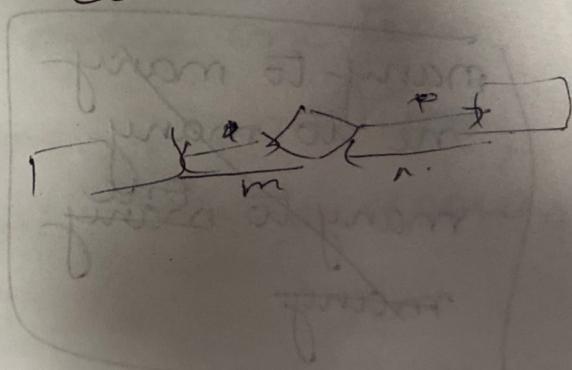
Course\_id

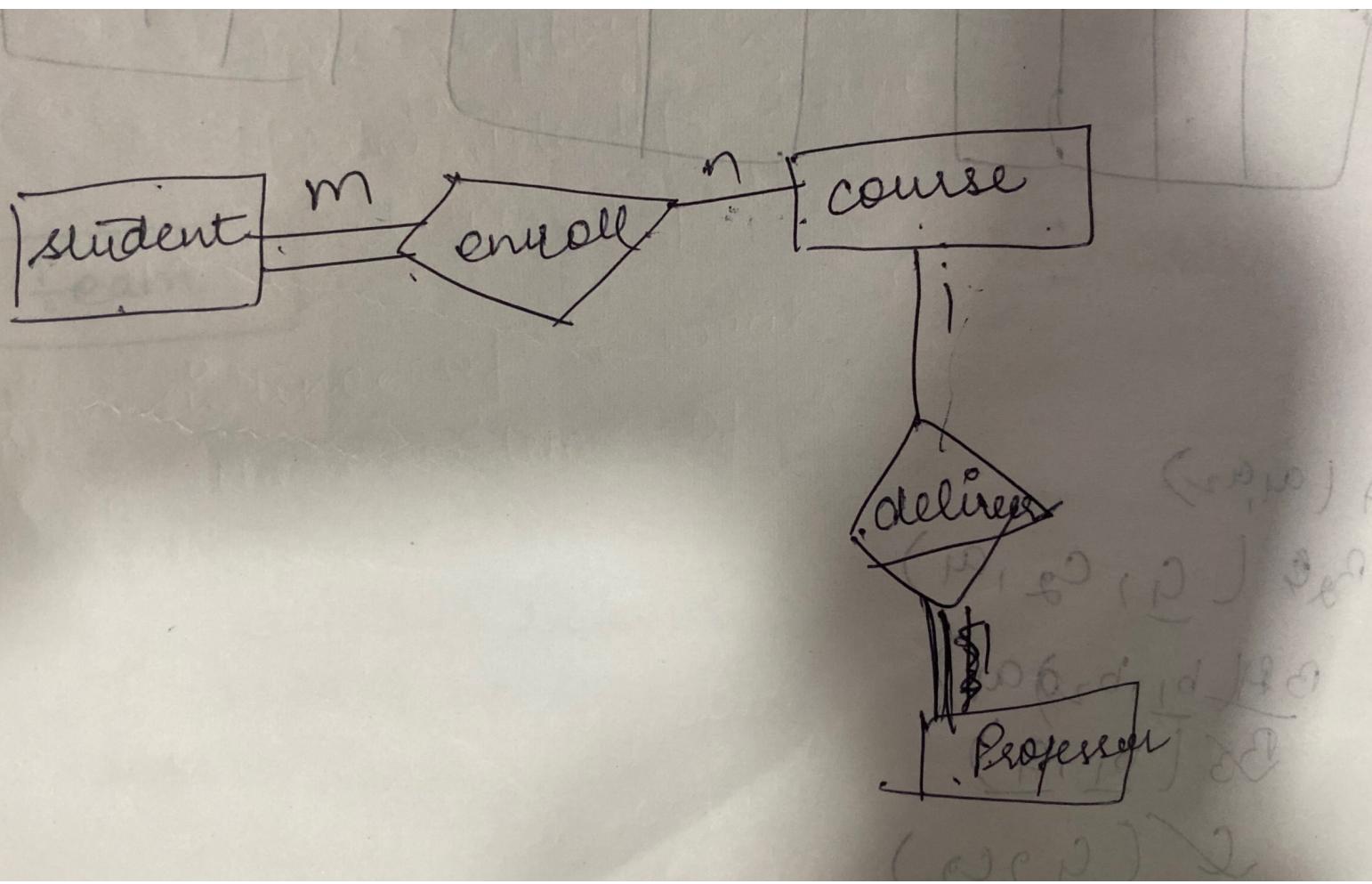
Attributes

st\_name

Professor name

Coursename



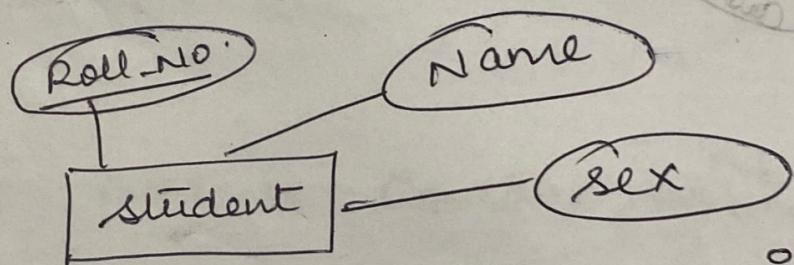


# Reducing ER-diag. into Relational Table

Rule-1 for strong entity set with only simple Attribute

A strong entity set with only simple attribute will require only one table in relational Model.

→ Attributes of the ~~table~~ entity set " " will be the



→ Primary key of the table will be the key attribute of the entity set.

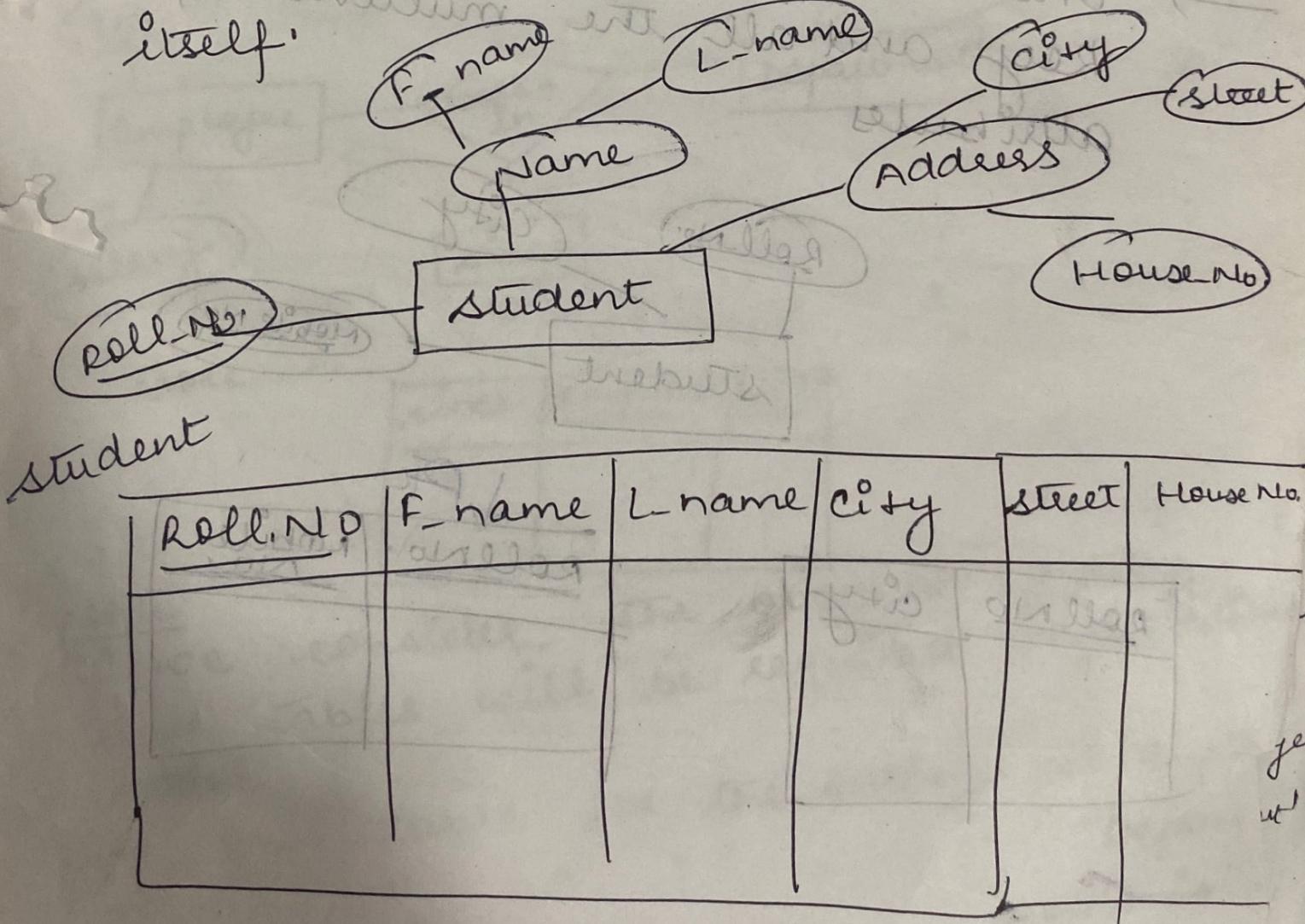
student

roll no.	Name	sex

## Rule-2 For strong entity set with Composite Attribute

A strong entity set with any no. of composite attributes will require only one table in relational model.

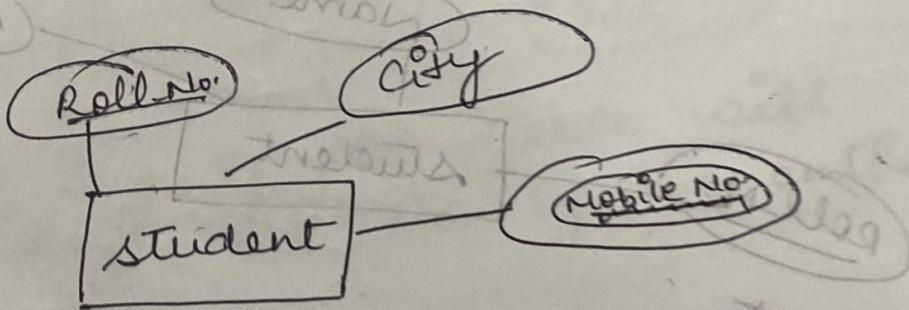
→ While conversion, simple attributes of the composite attributes are taken into account and not the composite attribute itself.



### Rule 3 For Strong entity set with Multivalued attribute

A strong entity set with any no. of multivalued attributes will require two tables in relational model.

- One table will contain all the simple attribute with the primary key.
- One table will contain the primary key and all the multivalued attributes.



roll no.	city

roll no.	mobile no.

## Rule-4

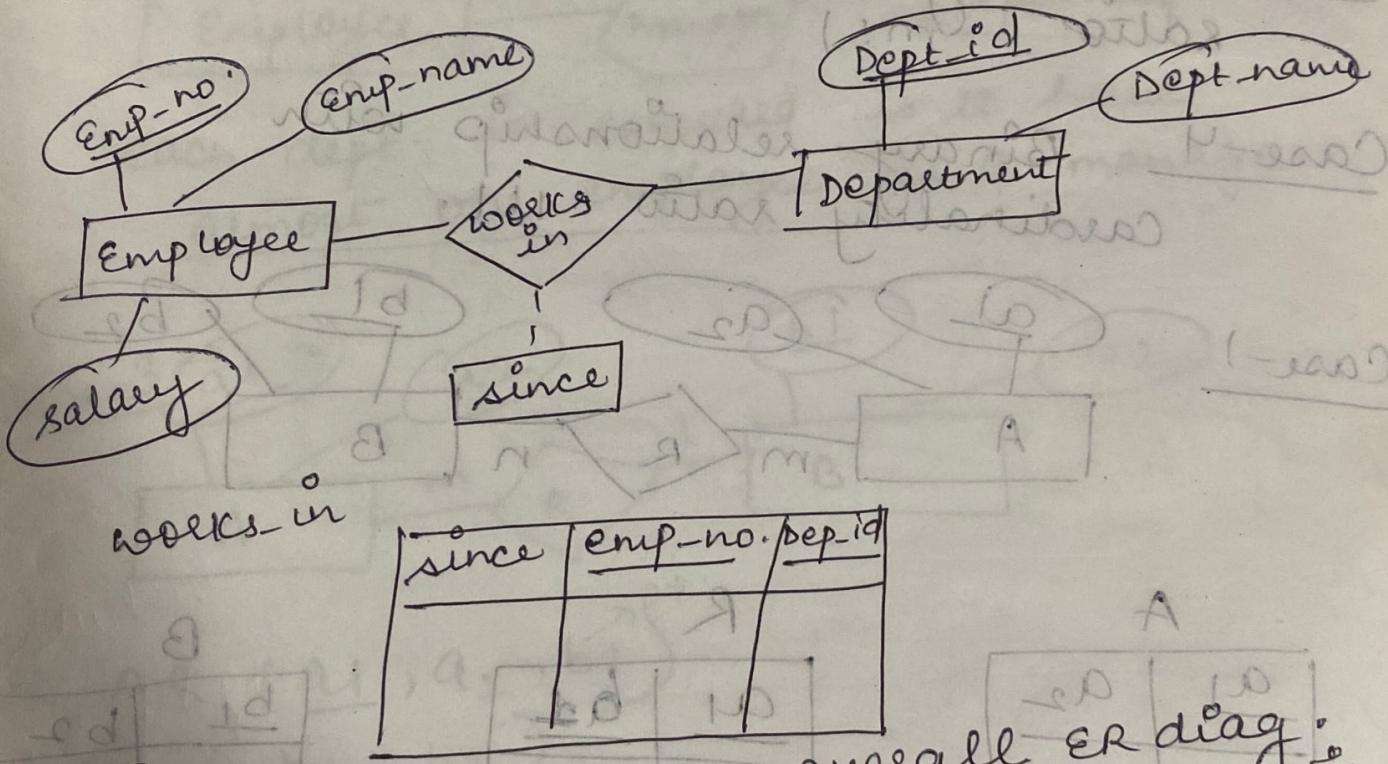
Translating Relationship set into  
a Table

A relationship set will require one table in the relational model.

Attributes of the tables are

→ Primary key  
entity sets

→ It owns descriptive attributes if any.



Note: If we consider the overall ER diag., three tables will be required in Relational model. For the entity set "Employees",

three tables model.

→ One table for the entity set "Employees"  
→ " " "  
→ " " "

Rule 5 For Binary Relationships with Cardinality Ratios —

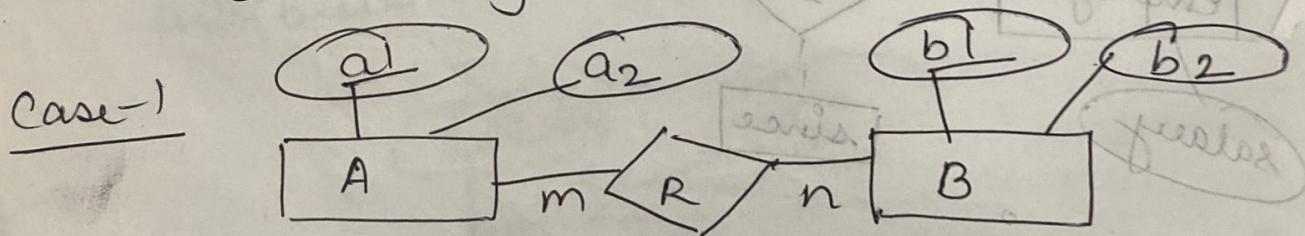
The following four cases are possible —

Case-1 Binary relationship with cardinality ratio 1:n.

Case-2 Binary relationship with cardinality ratio 1:n.

Case-3 Binary relationship with cardinality ratio 1: n.

Case-4 Binary relationship with  
Cardinality ratio 1:1.

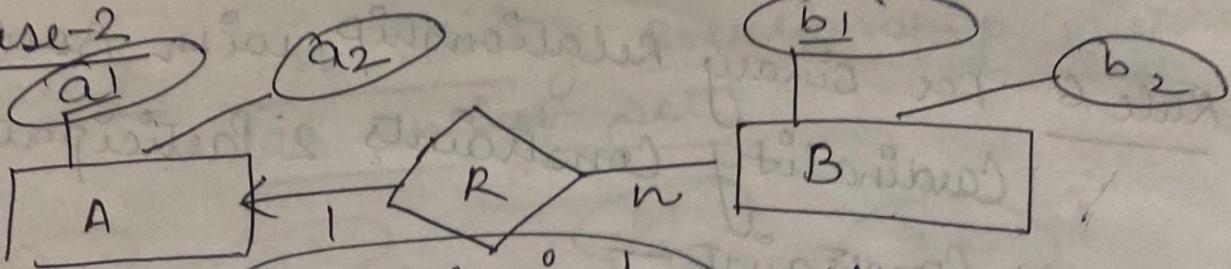


<u>a<sub>1</sub></u>	a <sub>2</sub>
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Pigmentos que se crean

<u>b<sub>1</sub></u>	<u>b<sub>2</sub></u>
<u>W<sub>04</sub></u>	<u>984</u>

Case-2

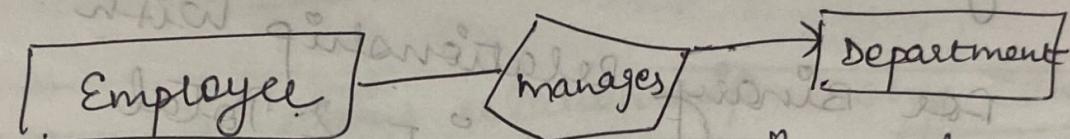


max. cardinality is 1  
is also acceptable

$A(a_1, a_2)$

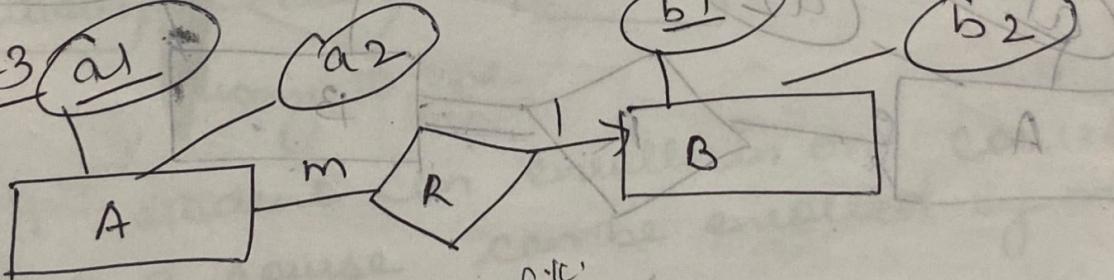
$BR(b_1, b_2, a_1)$

we combine them  
we need less  
duplicate values  
as possible.



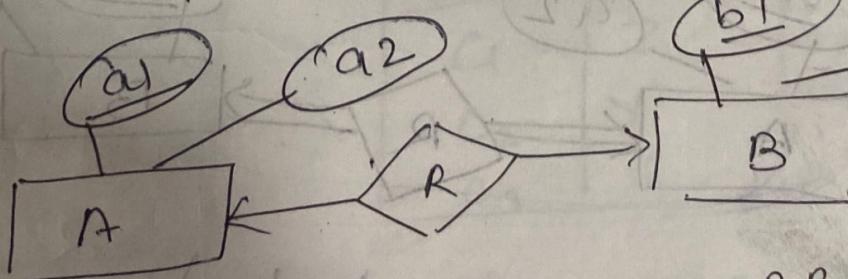
each dept. is required to have  
almost one employee as a manager.

Case-3 (a1)



$AR(a_1, a_2, b_1)$   
 $B(b_1, b_2)$

Case-4



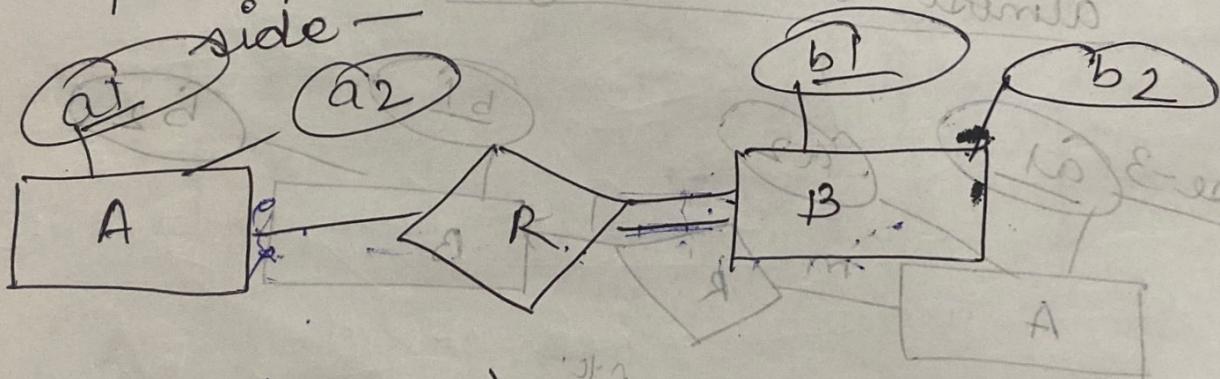
$AR(a_1, a_2, b_1)$   
 $B(b_1, b_2)$

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

Rule 6 For Binary Relationship with Both Cardinality Constraints & Participation Constraint -

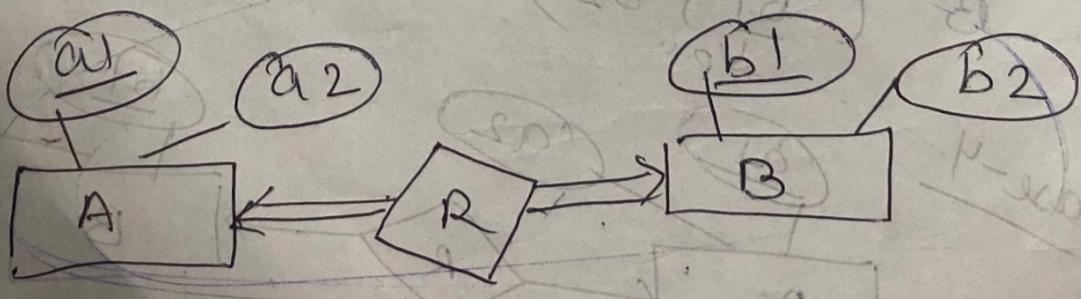
Because of the total participation constraint, foreign key acquires NOT NULL constraint i.e. now foreign key cannot be null.

Case-1 For Binary Relationship with Cardinality Constraint & Total participation constraint from one side -



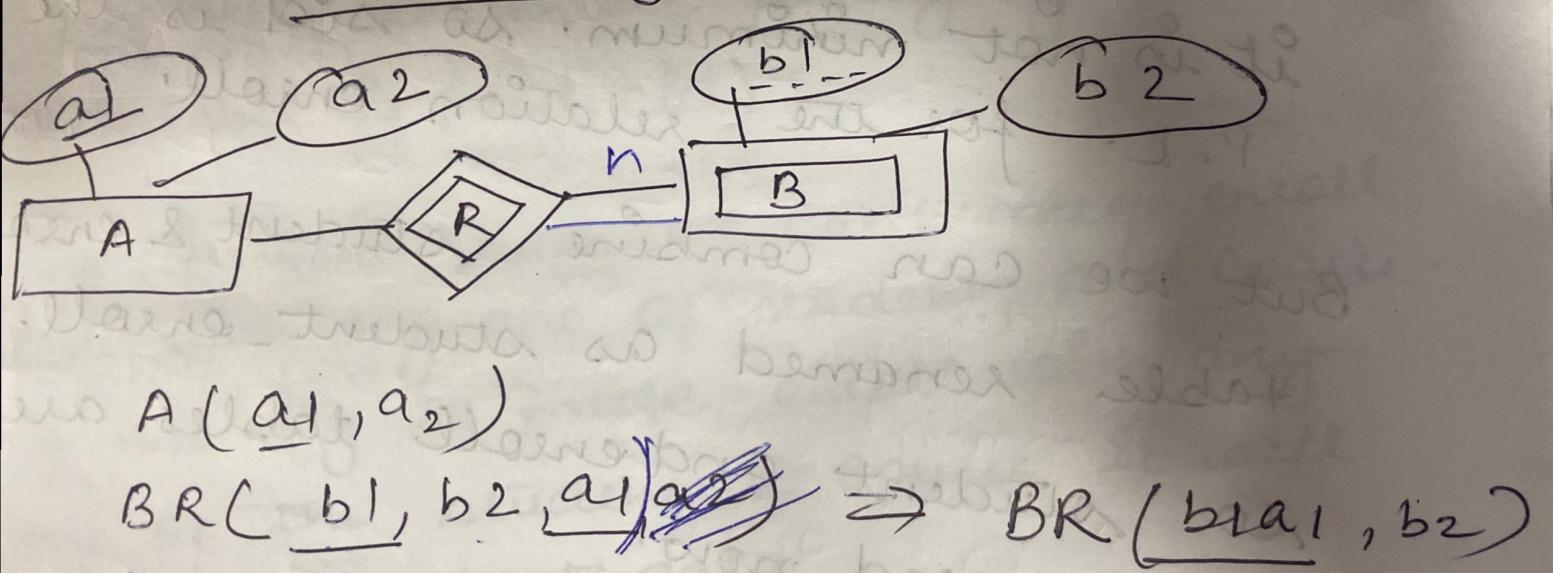
$A(a_1, a_2)$   
 $B(b_1, b_2, a_1)$

Case-2



$A \text{ } R \text{ } B (a_1, a_2, b_1, b_2)$

Rule 7 For Binary Relationship with weak entity set

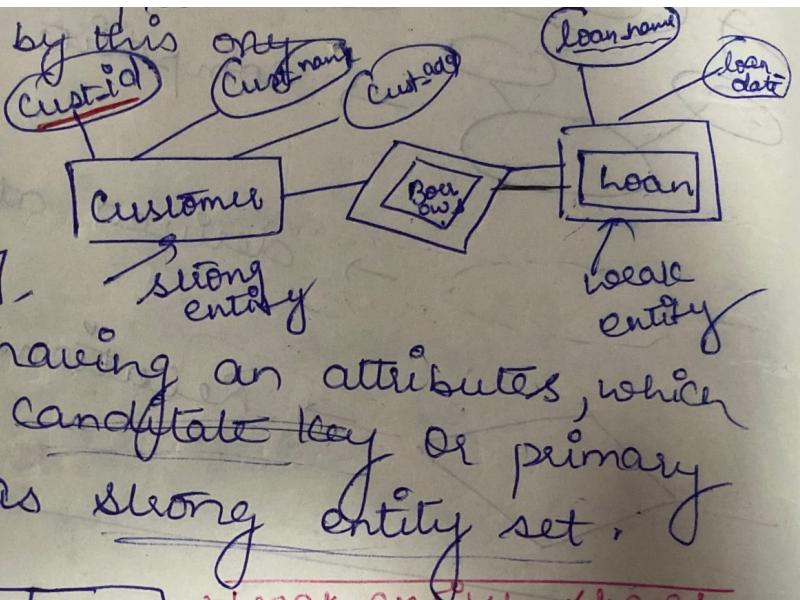


## Types of entity

### ① strong entity

An entity set can be used as key is called as strong entity set.

attribute	roll No.	Name	DOB	course	Address
student					



### weak entity shows

total participation.  
let us take ex. Room building without building room cannot exist so here participation of room is total. Now talking about building

### weak entity

A weak entity set doesn't have any primary key means the entity set which does not have sufficient attributes to form a primary key is called as weak