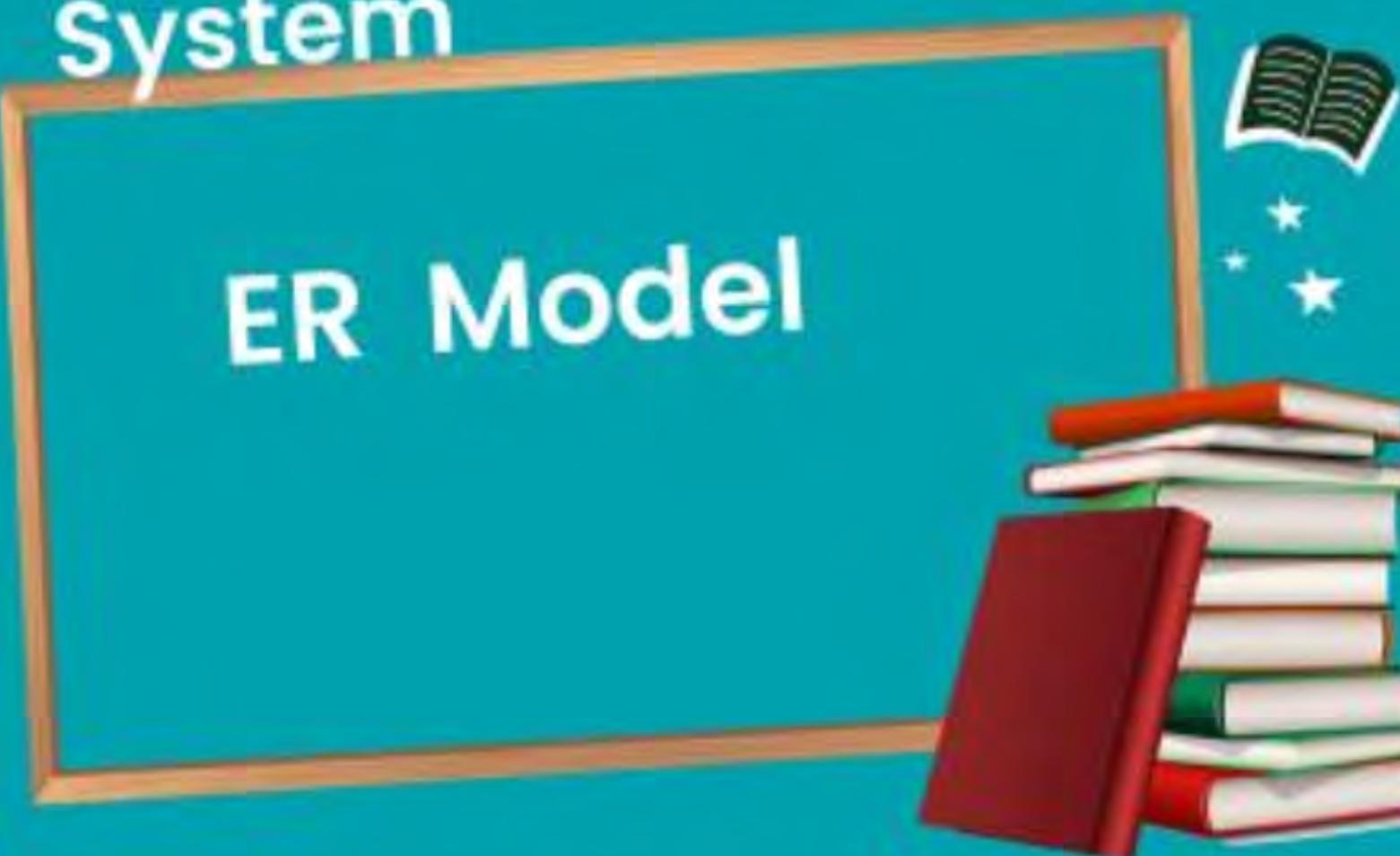


COMPUTER SCIENCE

Database Management System

ER Model



Lecture_1

Vijay Agarwal sir



A graphic of a construction barrier with orange and white diagonal stripes and two yellow bollards at the top. It is positioned on the left side of the slide.

**TOPICS
TO BE
COVERED**

01

ER MODEL

02

Foreign Key Concepts

✓ CHAPTER 1: FD & Normal Forms } 3-4 M

✓ CHAPTER 2: Transaction & Concurrency Control } 2-3 M

CHAPTER 3: ER Model, Foreign key, ER to RDBMS Conversion

CHAPTER 4: Query language } 3-4 M allig

CHAPTER 5: File org & Indexing } 1-3 M.

ER MODEL :

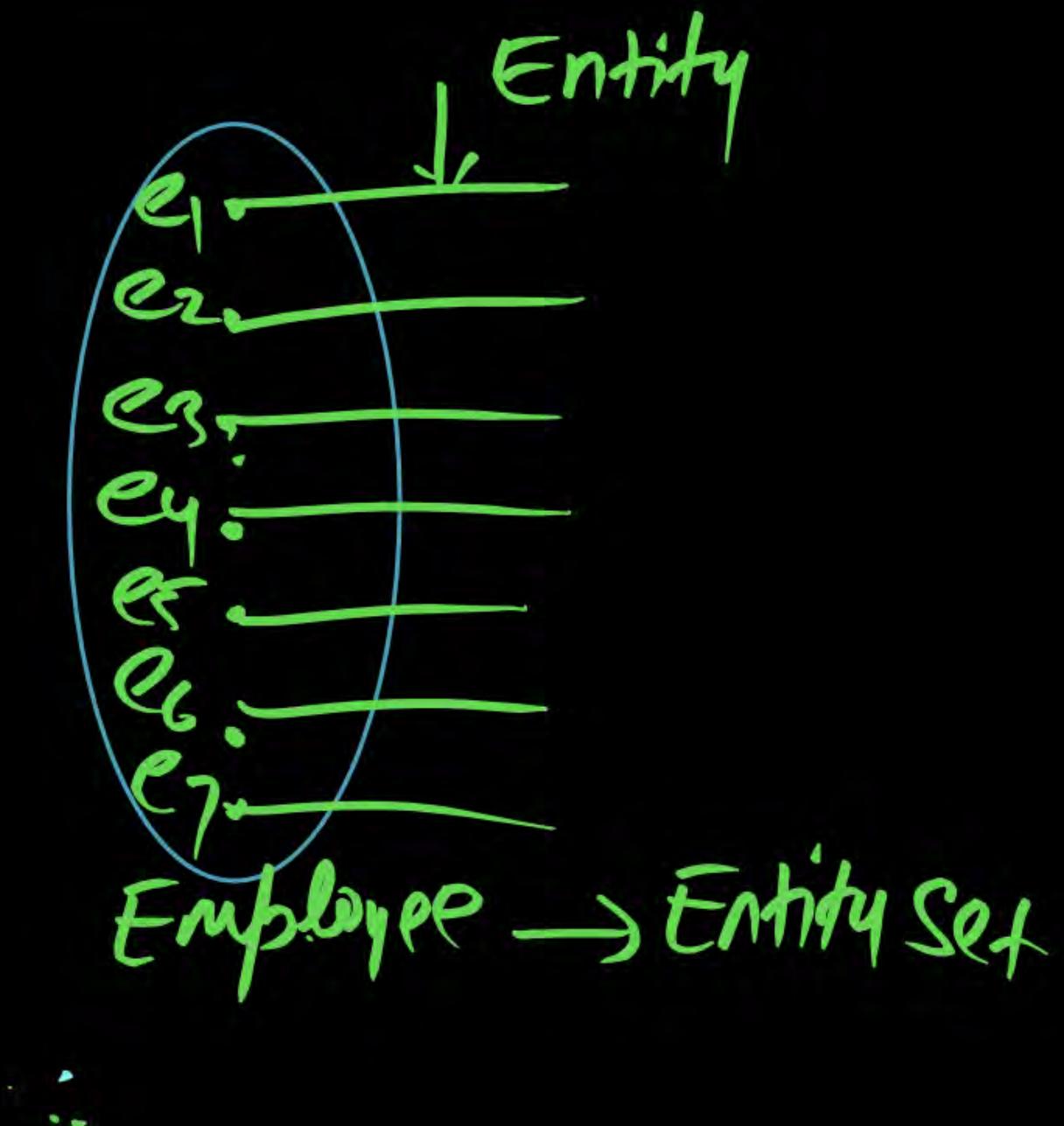
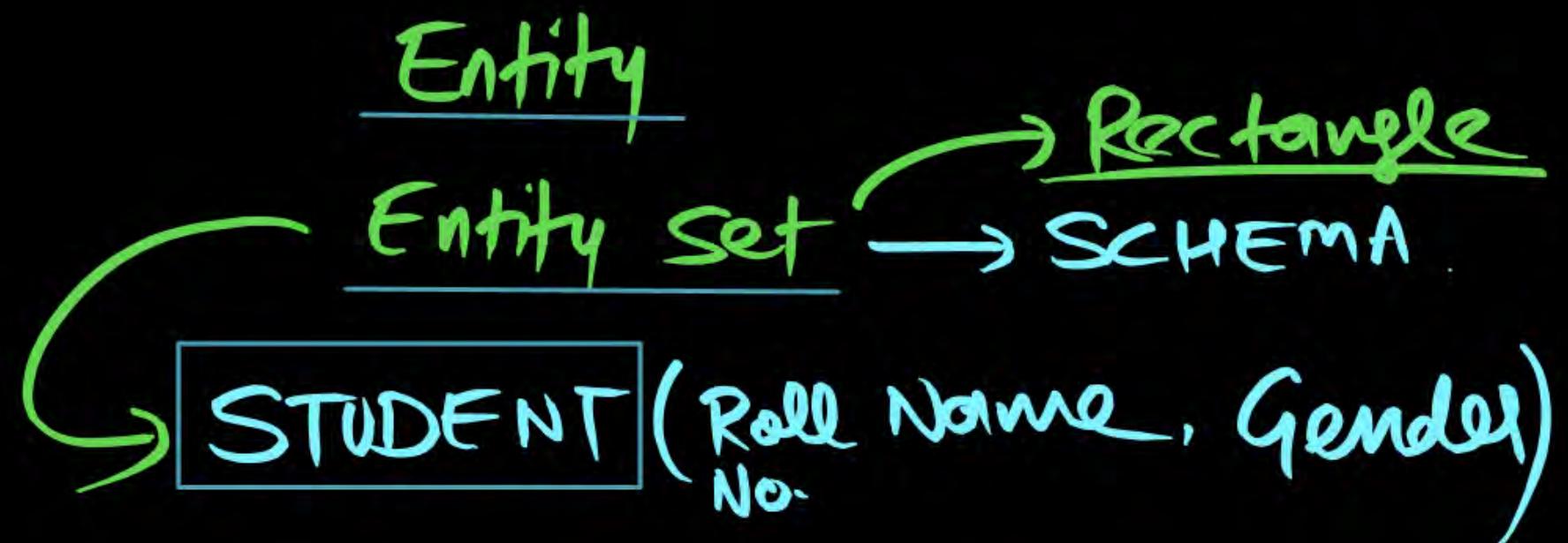
Entity - Relationship MODEL

Entity : Object in the Real Word

Entity Set : Collection of Similar Entity.

Entity – Relationship Model

(Conceptual Design)



Entity

An entity is an object that exists and is distinguishable from other objects.

- ❖ Example: Specific person

Entity Set

- An entity set is a set of entities of the same type that share the same properties.
 - ❖ Example: set of all persons, companies

- Entities have attributes
 - ❖ Example: people have names and addresses

Rectangle → 

Entity sets instructor and student

instructor_ID instructor_name

| | |
|-------|------------|
| 76766 | Crick |
| 45565 | Katz |
| 10101 | Srinivasan |
| 98345 | Kim |
| 76543 | Singh |
| 22222 | Einstein |

instructor

student_ID student_name

| | |
|-------|---------|
| 98988 | Tanaka |
| 12345 | Shankar |
| 00128 | Zhang |
| 76543 | Brown |
| 76653 | Aoi |
| 23121 | Chavez |
| 44553 | Peltier |

student

entity

→ Entity set

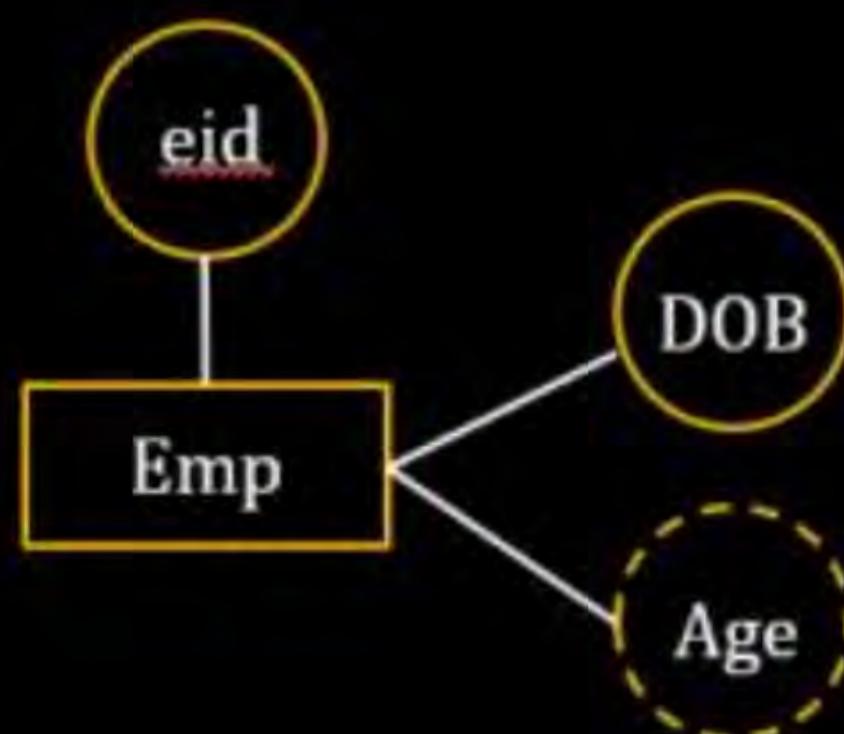
Entity Set

It is a set of entities of the same type denoted by a rectangular box in ER diagram. Entity can be identified by a list of attributes which are placed in ovals.

Represented By:



Example:



Noun

Entity
Entity Set

verb

Relationship : Association Among the entity.

Relationship Set : Collection

Relationship Sets

- A relationship is an association among several entities

❖ Example:

44553(Peltier) advisor

22222(Einstein)

~~student entity~~ — relationship set ~~instructor entity~~

- A relationship set is a mathematical relation among $n \geq 2$ entities, each taken from entity sets

$\{(e_1, e_2, \dots, e_n) \mid e_1 \in E_1, e_2 \in E_2, \dots, e_n \in E_n\}$

where (e_1, e_2, \dots, e_n) is a relationship

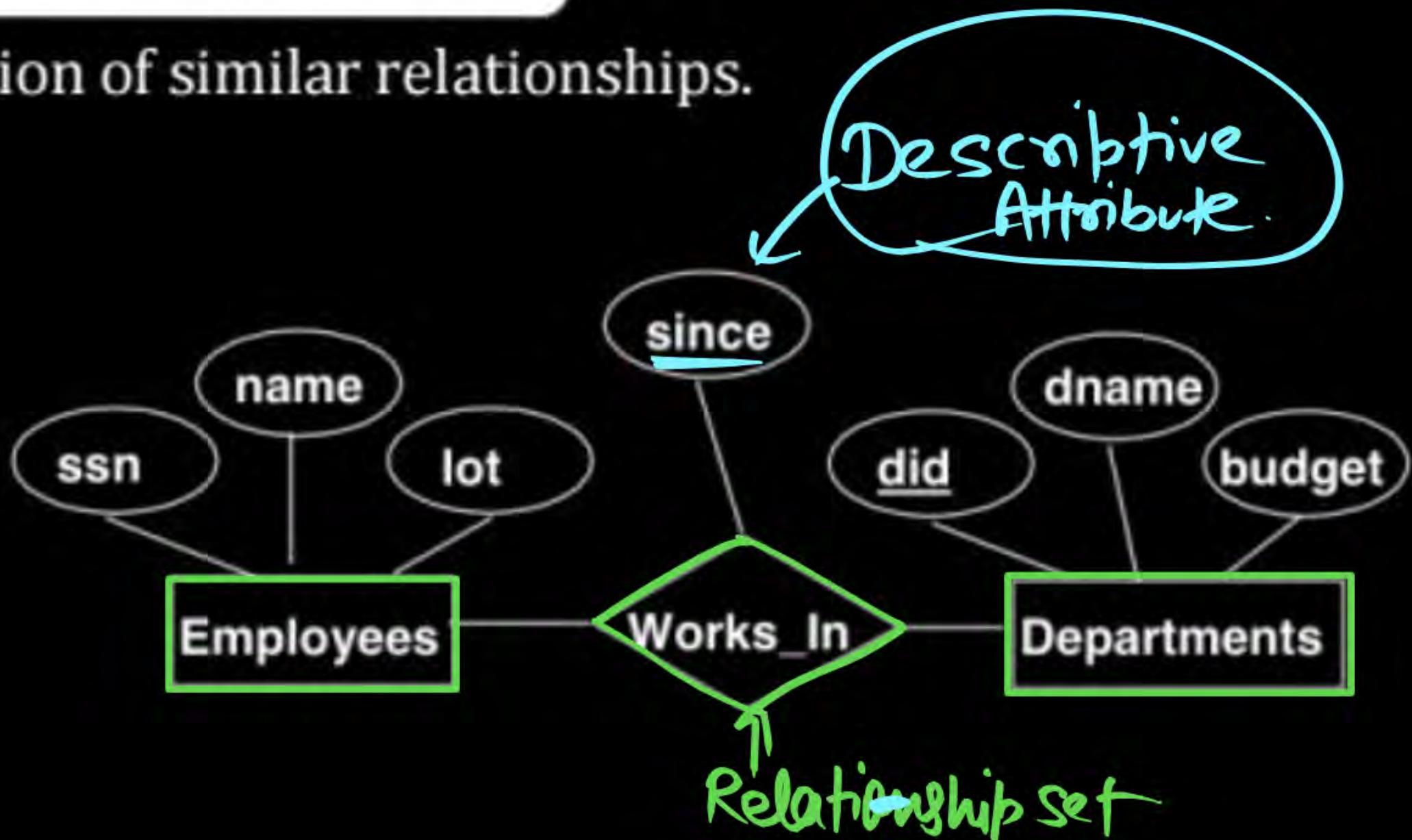
❖ Example:

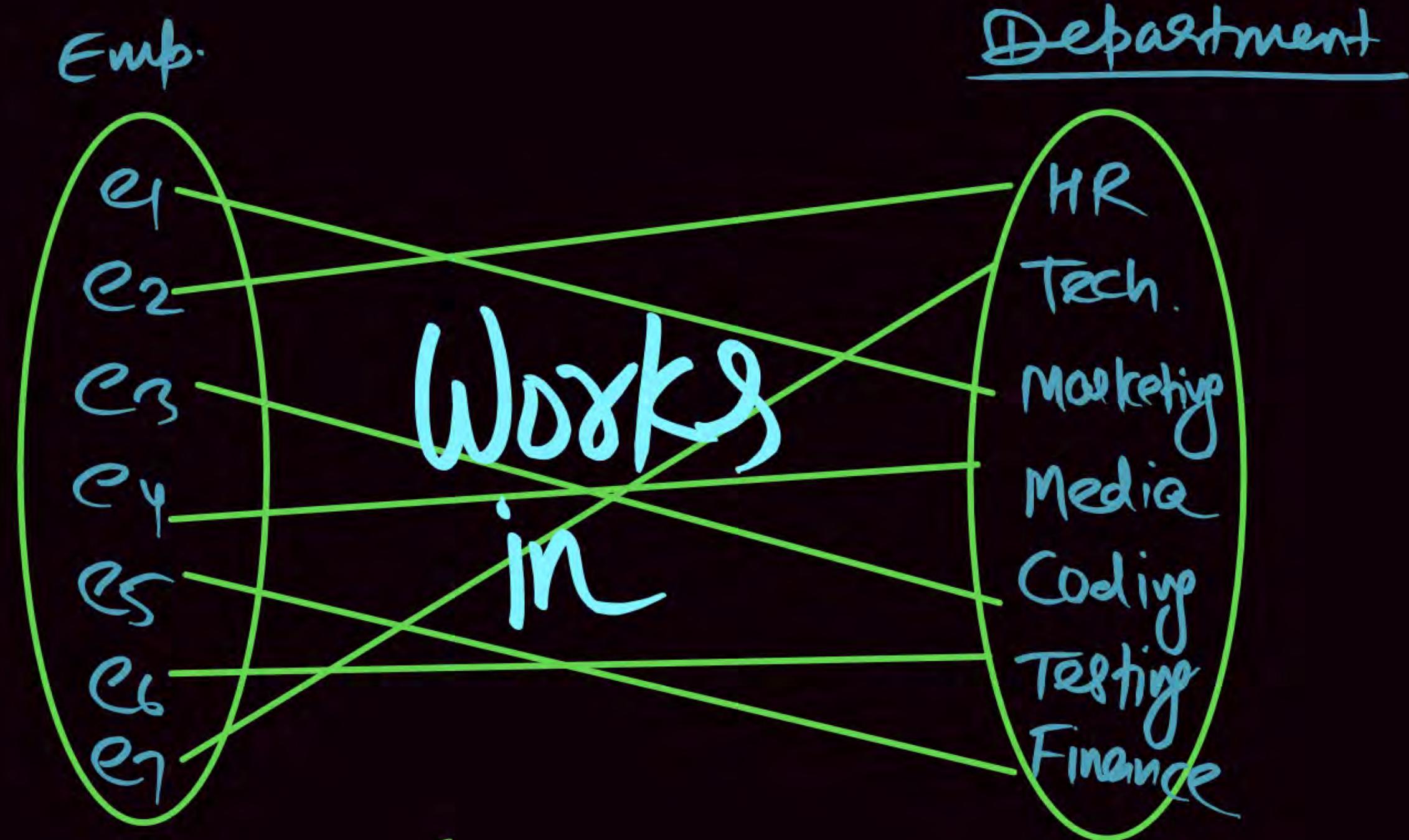
(44553, 22222) ∈ advisor

or

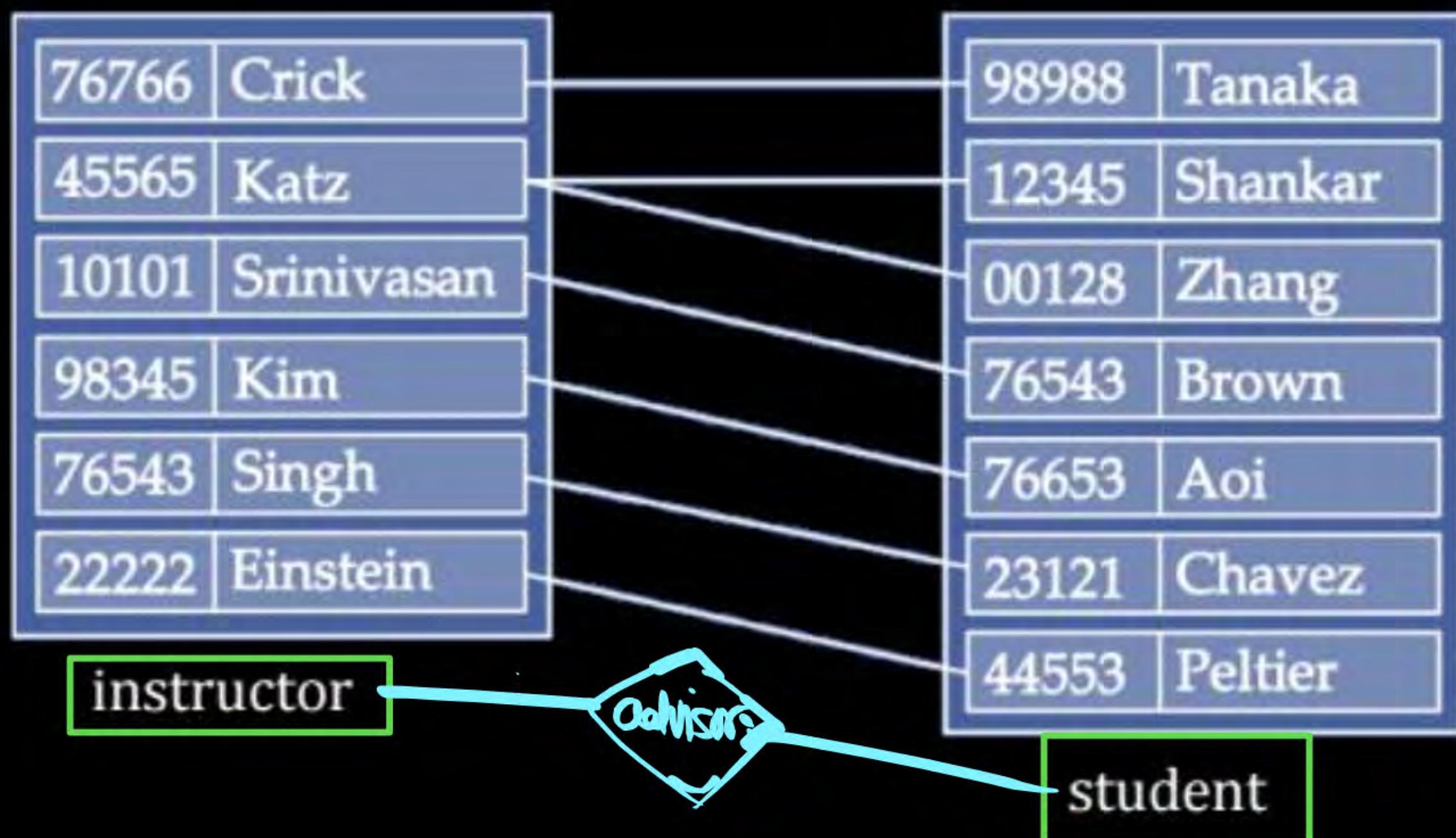
Relationship Sets

- Collection of similar relationships.



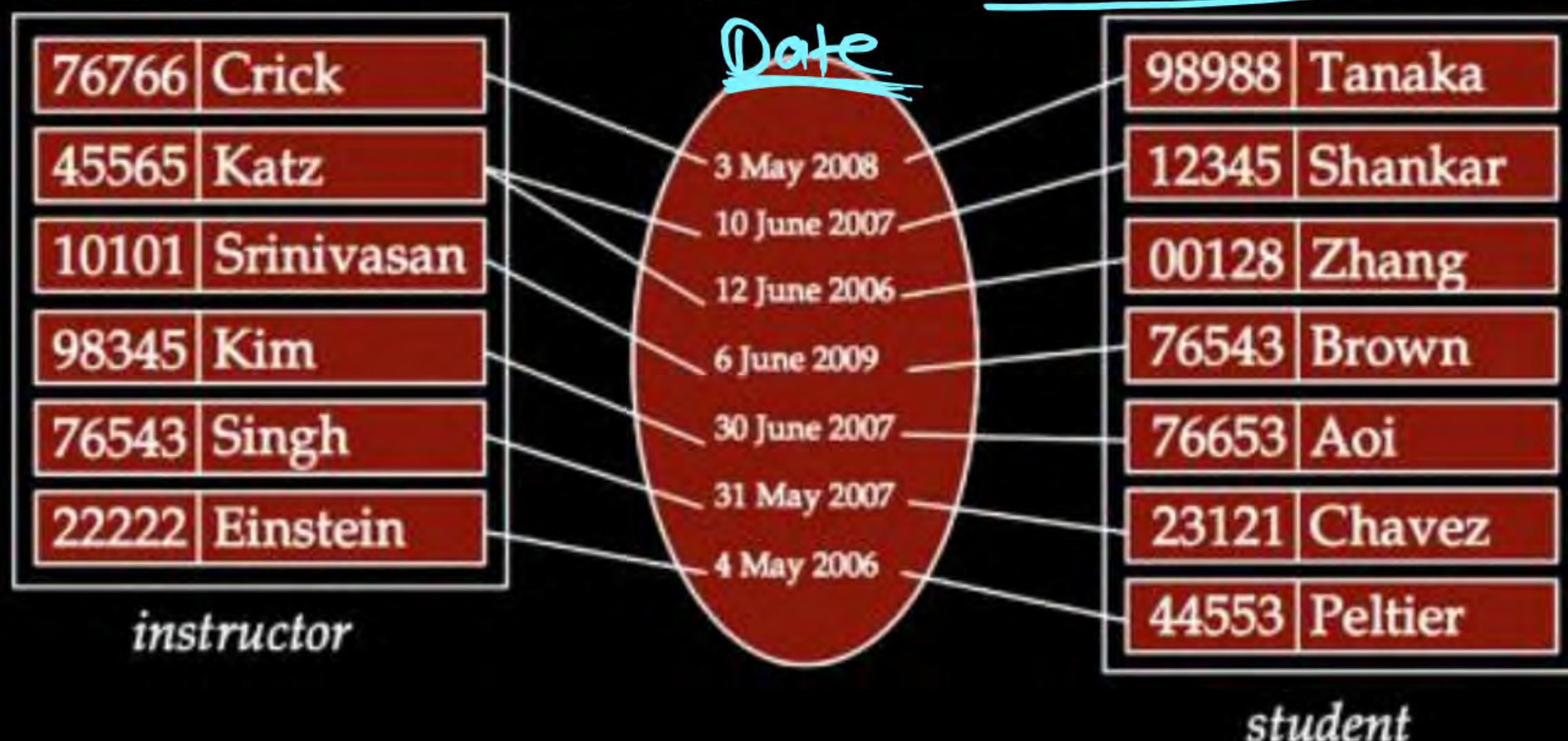


Relationship Set advisor



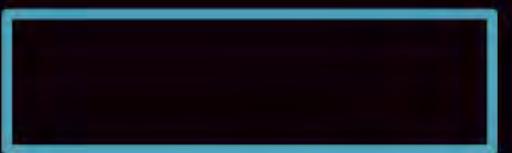
Relationship Sets

- An attribute can also be property of a relationship set.
- For instance, the advisor relationship set between entity sets instructor and student may have the attribute date which tracks when the student started being associated with the advisor



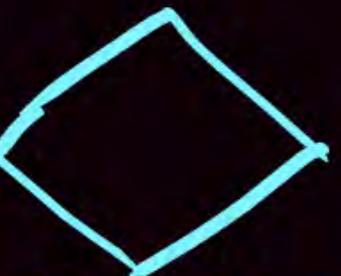
Entity

Entity Set



Relationship

Relationship Set



Attribute

Attributes

Attributes are properties used to describe an entity.

Attribute types:

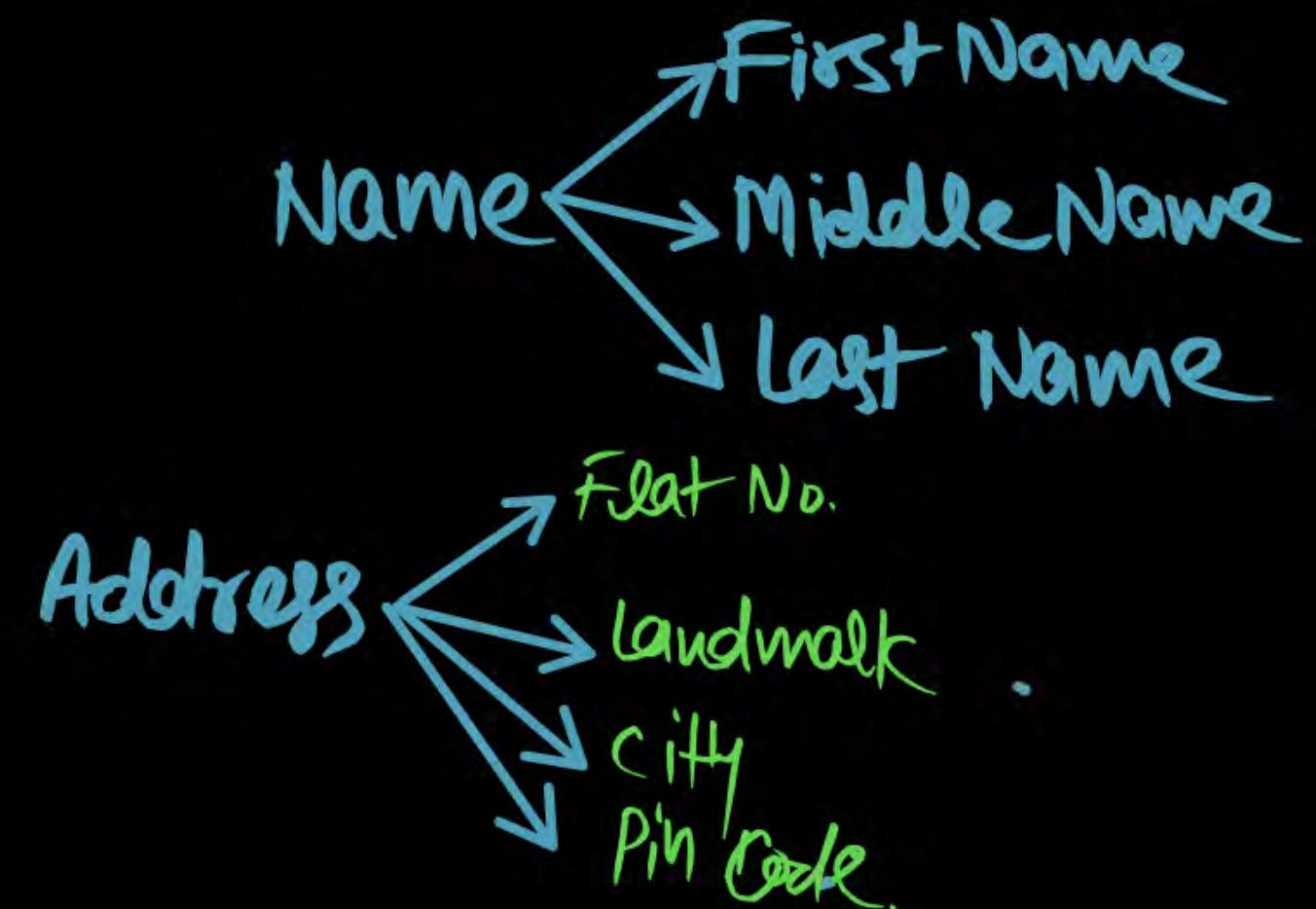
- ✓ (1) Simple and composite attributes.
- ✓ (2) Single-valued and multivalued attributes
- ✓ (3) Stored and Derived attributes
- (4) key attribute

⑤ Complex Attribute
⑥ Descriptive Attribute

Simple Attribute

which can not divide further.

Roll No



Composite Attribute

which can be divided further.

1) Simple & Composite attribute

Simple

Each entity has a single atomic value for the attribute. For example, SSN or Sex (Gender)

Composite

The attribute may be composed of several components. For example



2) Single-valued and multivalued attributes

Single Valued Attribute : Which takes One Value Per Entity.

(3)

Gender

Roll No.

Result

Multi Valued Attribute : Which takes More than One Value Per entity.

Mobile No.

email

3) Stored and Derived attributes

Stored Attribute : Which does not require Any updation.

(eg)

D.O.B

(eg)

D.O.T

Derived Attribute

The Value of the Attribute derived from other Attribute.

e.g DOB: 25/08/2000

2023: 23 yrs. (eg)

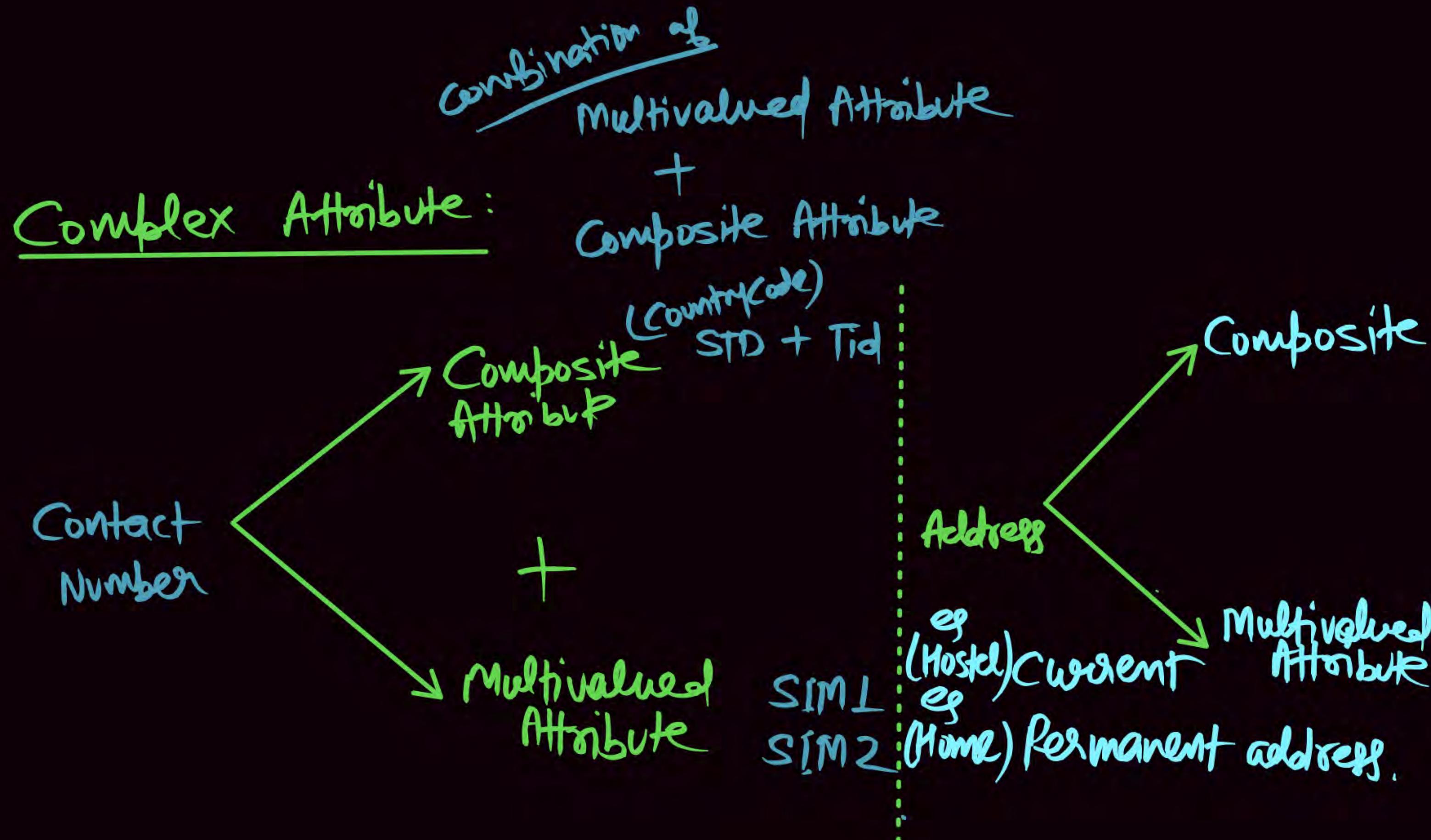
2030: 30 yrs.

2050: 50 yrs.

2090: 90 yrs.

: Age :

(eg) (Year of Service)



4) Key and Descriptive attributes

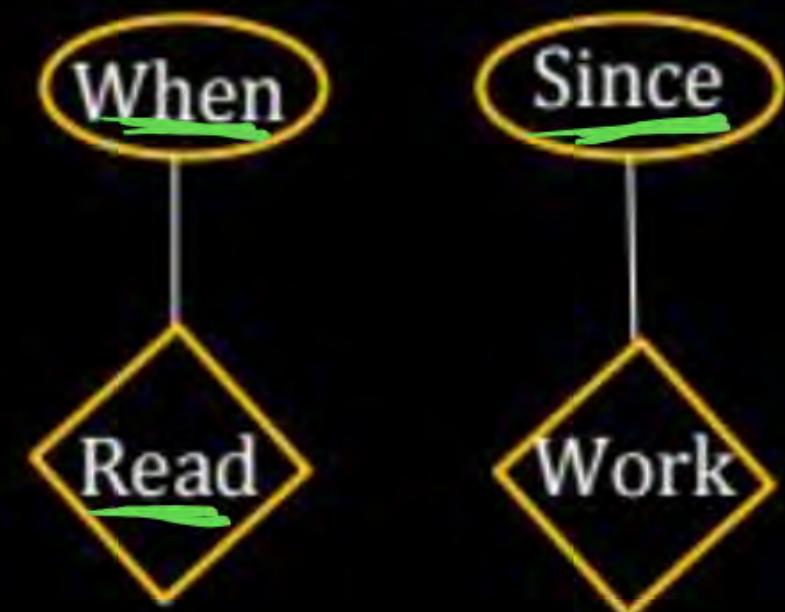
Key Attribute:

Which uniquely Identify an entity in the entity set.

Roll Number

Descriptive Attribute:

Which gives information about the relationship set



Entity
Entity Set

Relationship
Relationship Set

Attribute & its type

- ① Simple
 - ② Composite
 - ③ Single valued
 - ④ Multi valued
 - ⑤ Stored
 - ⑥ Derived
 - ⑦ Complex
- Attribute
- ⑧ key attribute
 - ⑨ Descriptive
- Attribute .

Degree of Relationship set

How Many Number of

Entity Set

Participate in a Relationship Set

① Unary (only one Entity set)

② Binary (Two Entity set.)

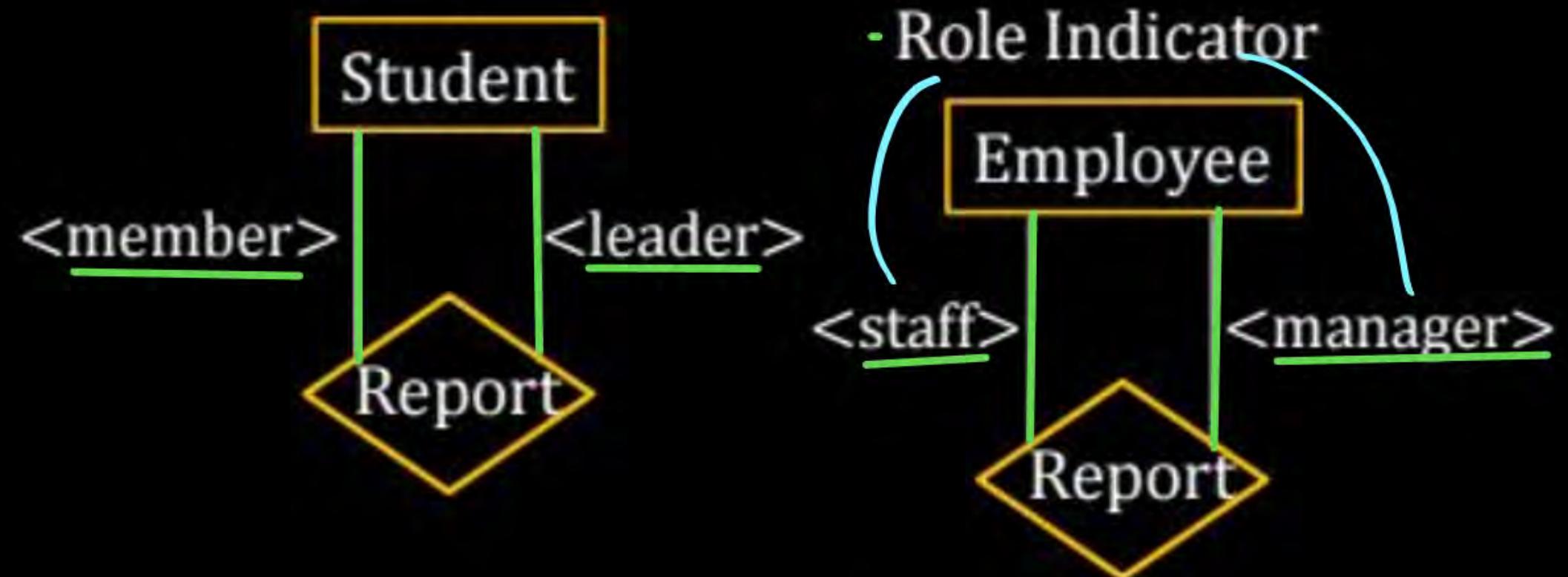
③ Ternary (Three Entity set)

④ N-ary (N- Entity set)

Degree of Relationship Set

Degree of Relationship Set: Specifies the numbers of Entity set participate in a relationship set

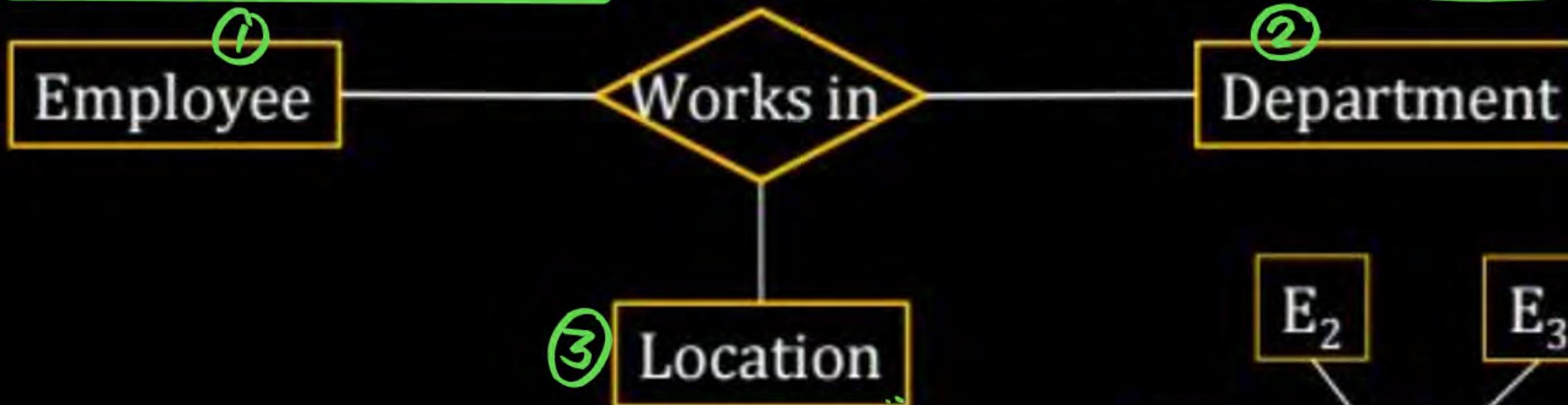
1) UNARY: Relationship among two entities of the same entity set
[Recursive Relationship Set]



2) Binary Relationship: The relationship among two entity set

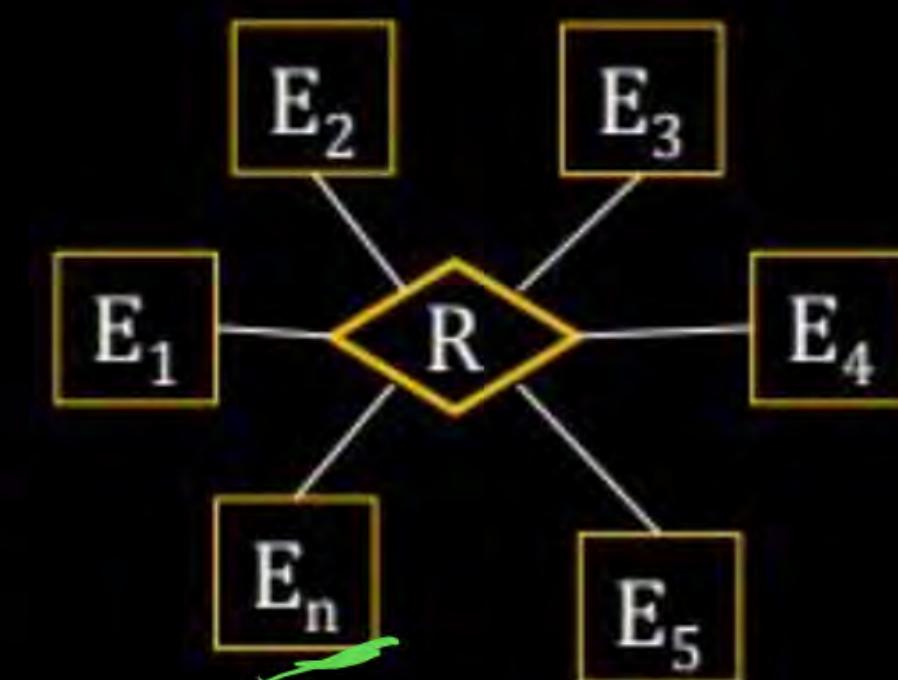


2) Ternary Relationship: The relationship among three entity set



3) n-ary Relationship:

The relationship among n-entity set



Entity
Entity Set

Relationship

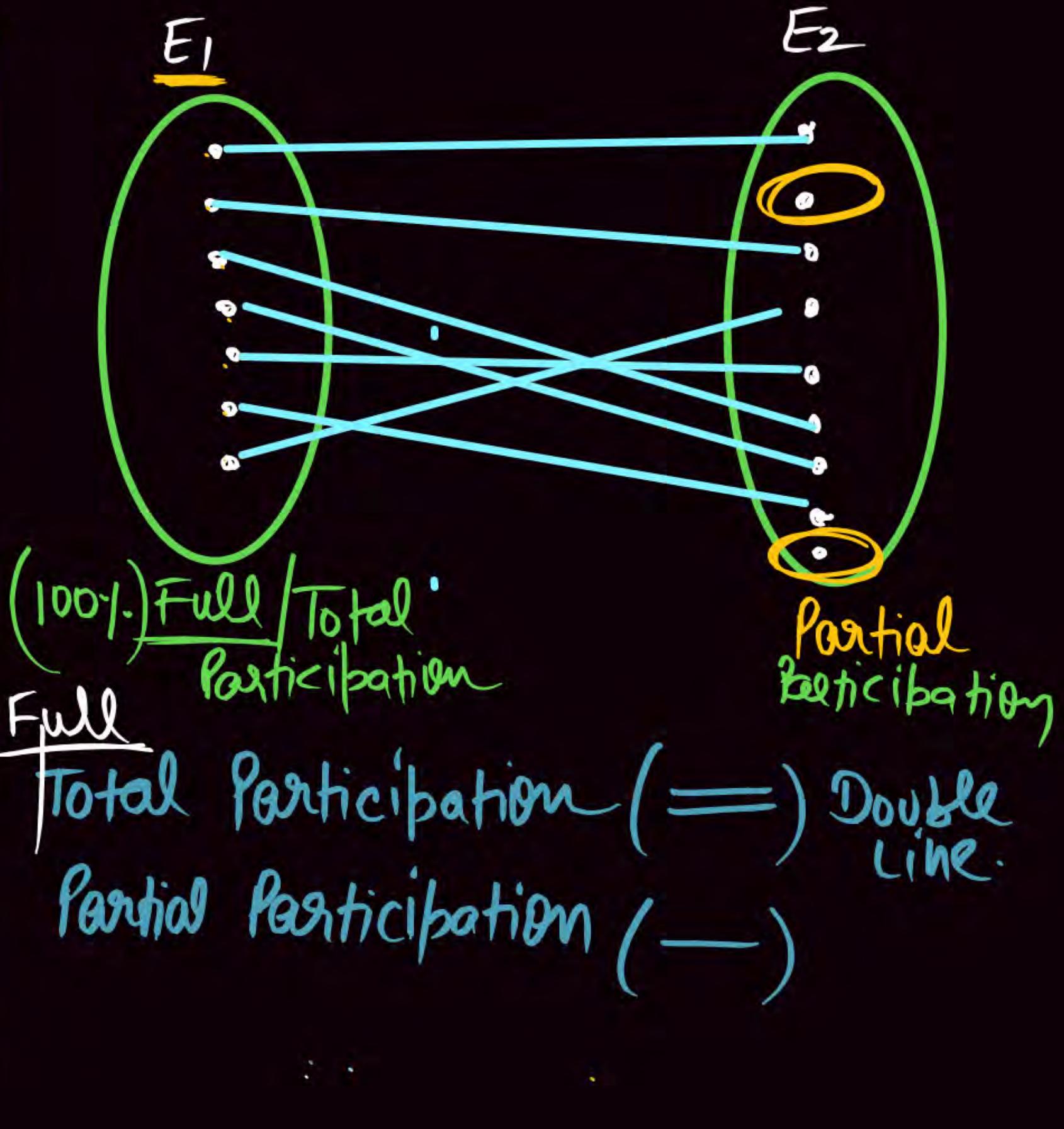
Relationship Set

Attribute & its type

Degree of Relationship Set

Entity Set

- ① Unary
- ② Binary
- ③ Ternary
- ④ N-ary.



Participation Constraint

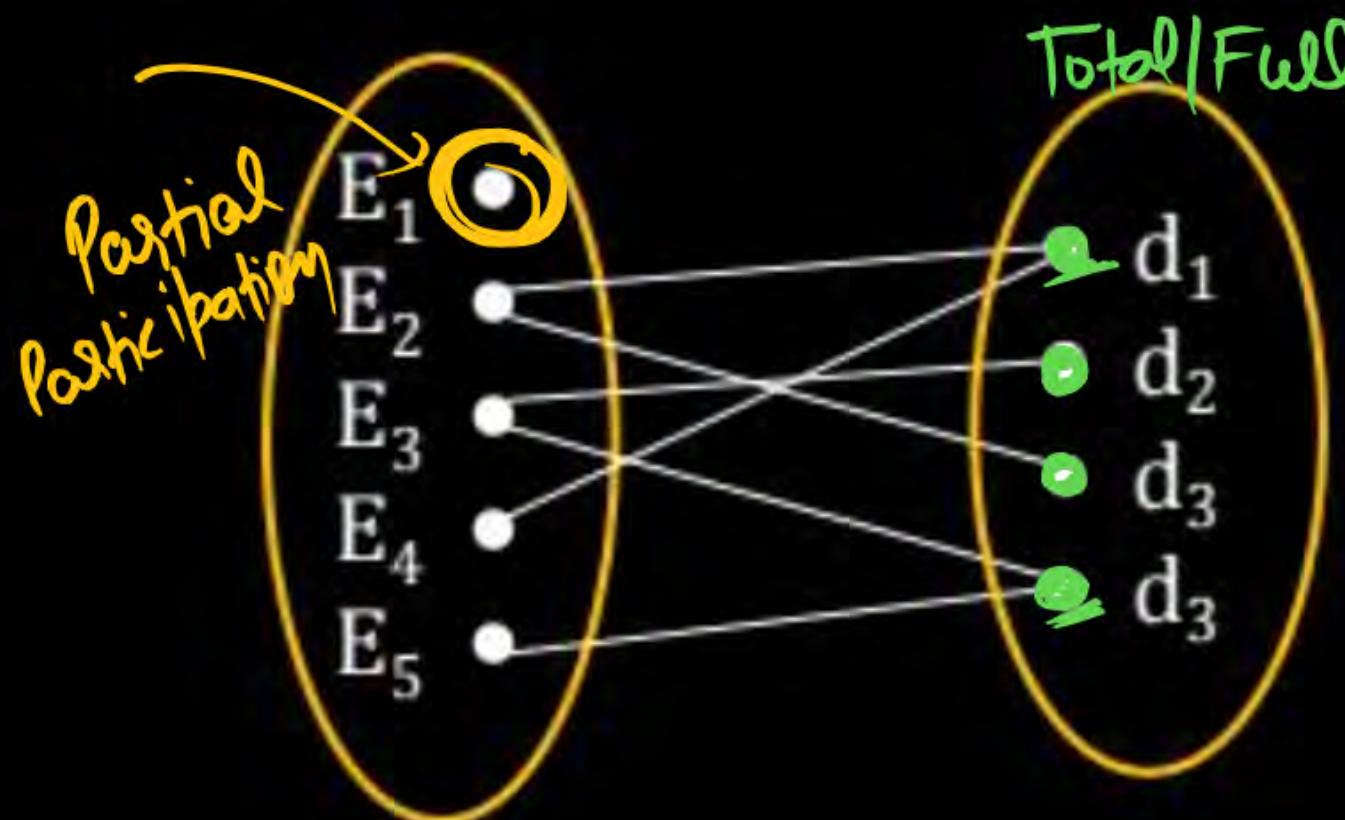
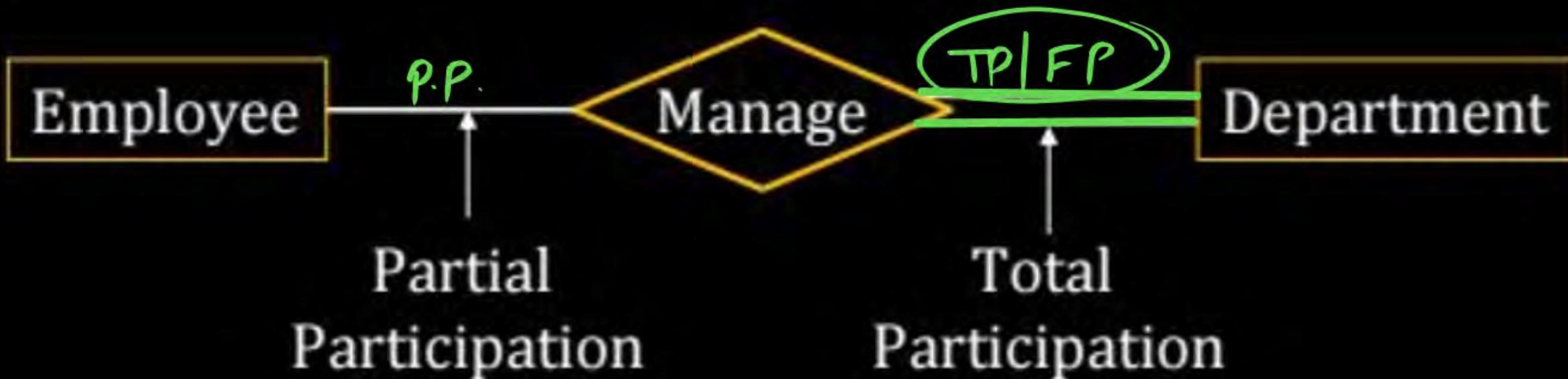
If every entity in the entity set participates in a relationship set is called

Total participation denoted by double line (thick line)
otherwise it is called partial participation (thin line or single line)

Q.

Each department is managed by at least one employee

P
W

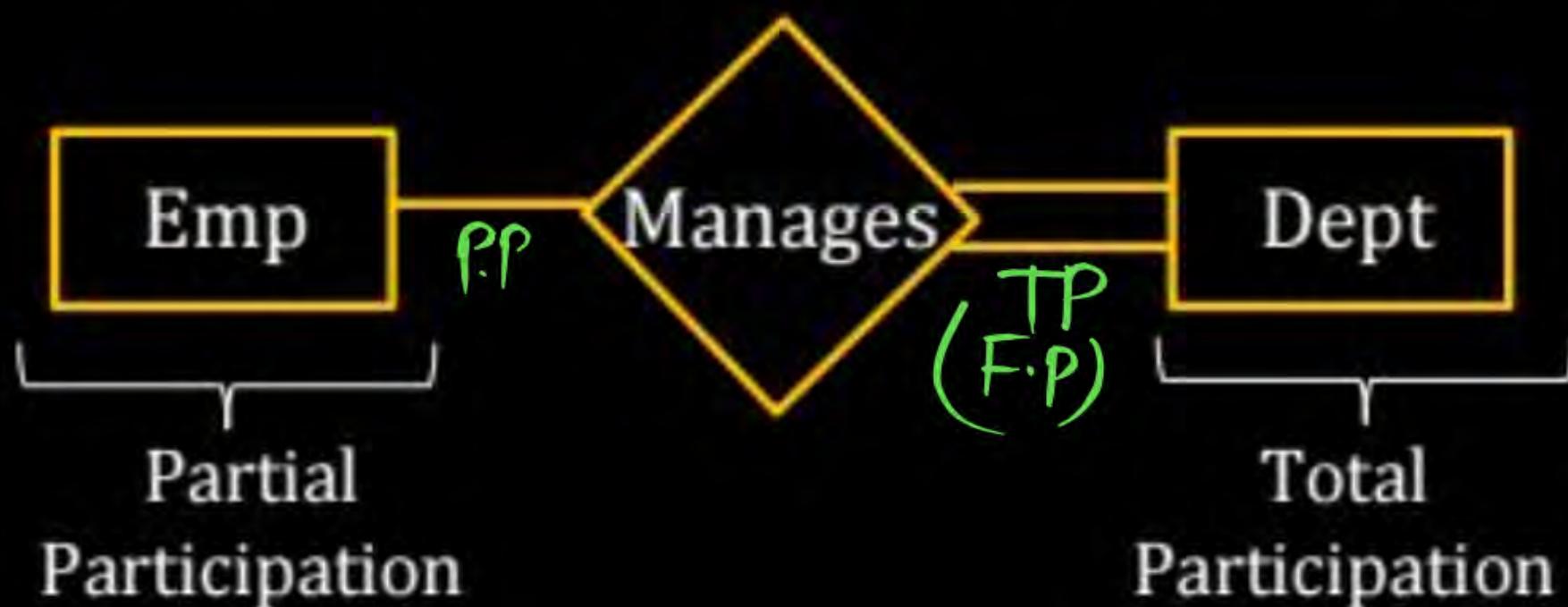


Participation

- If every entities of entity set are participated with relationship set then
it is total participation (100% participation) otherwise it will be partial
participation (< 100% participation)

Example : Consider Emp and Dept entity set.

Manages relationship set such that each dept must have manager.



Entity
Entity Set

Relationship

Relationship Set

Attribute & its type

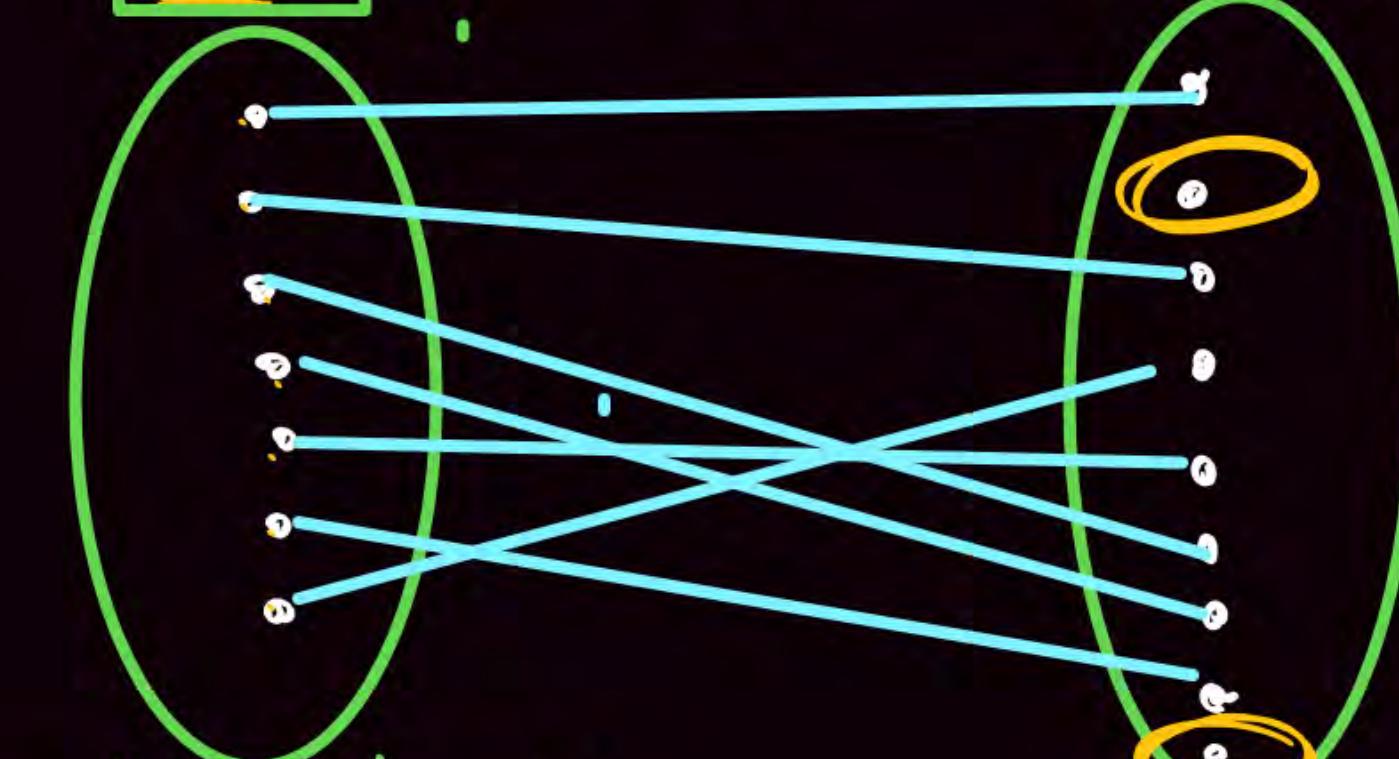
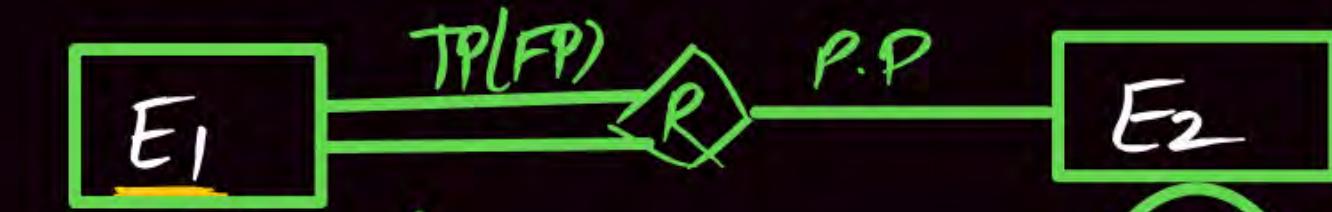
Degree of Relationship Set

Entity Set

- ① Unary
- ② Binary
- ③ Ternary
- ④ N-ary.

Cardinality

entities



(100%.) Full / Total
Participation

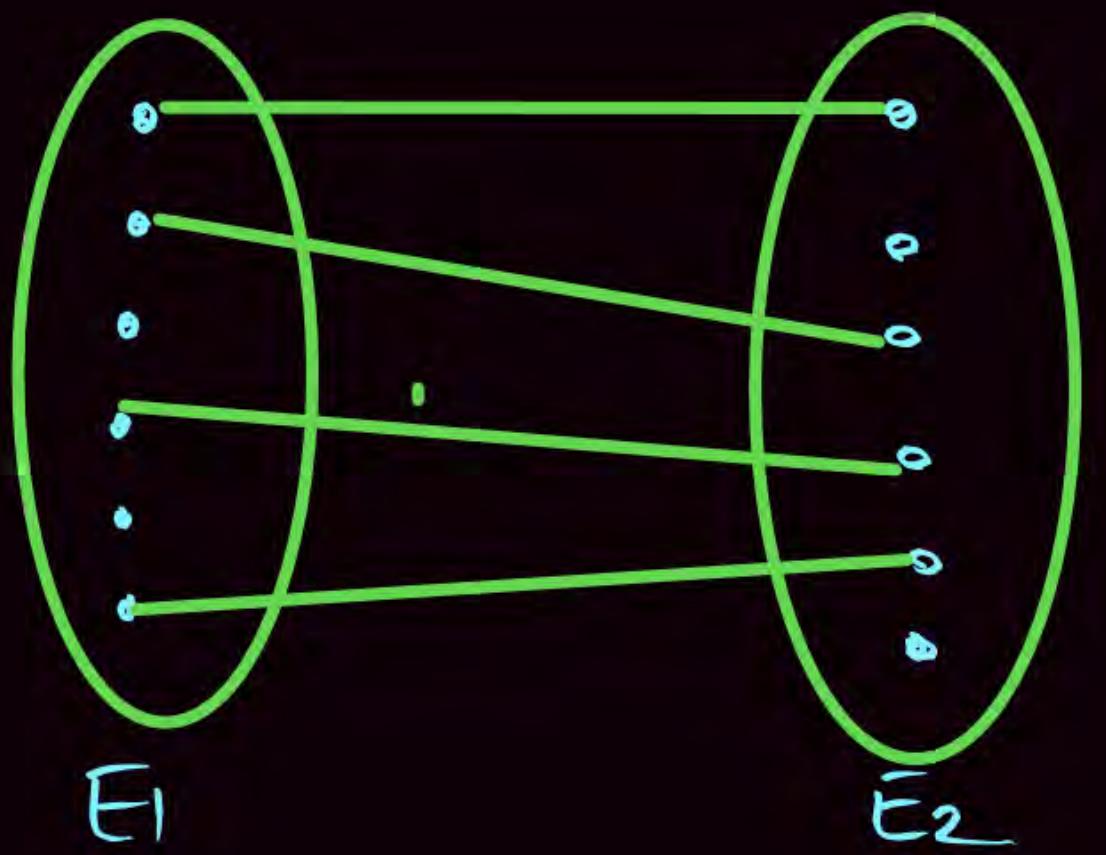
Full
Total Participation (=) Double
Line.

Partial Participation (-)

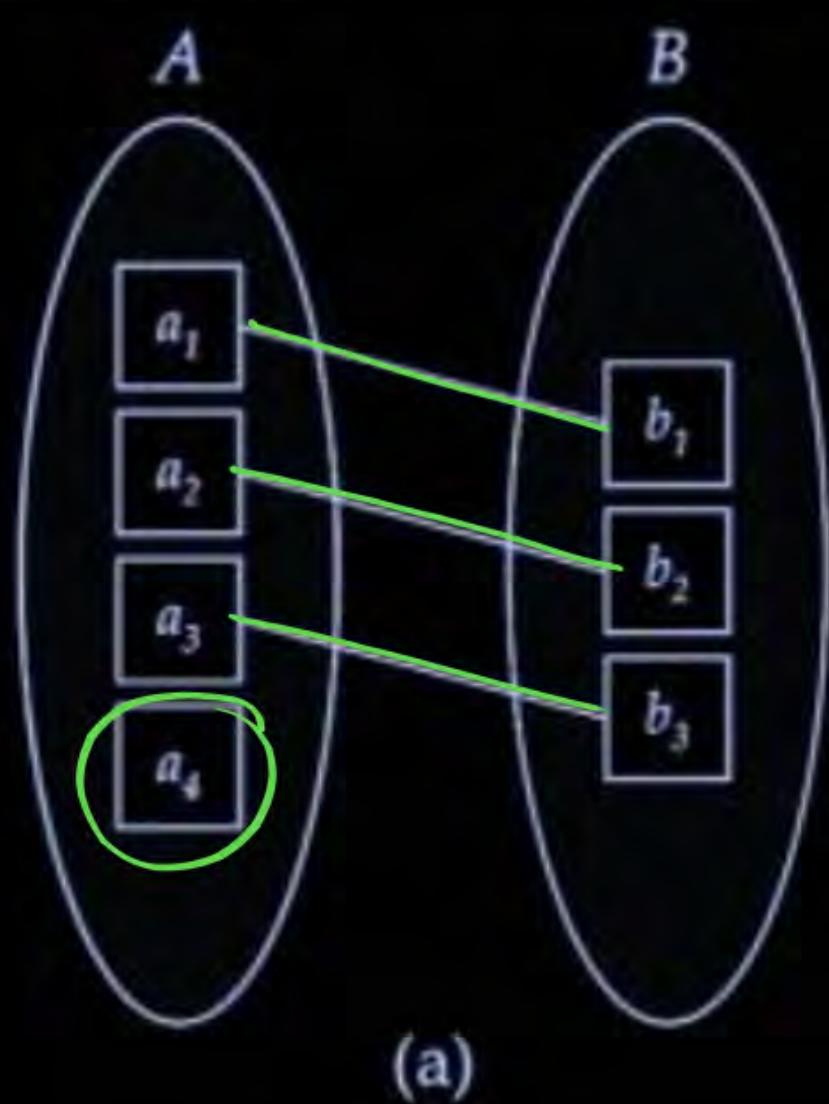
Partial
Participation

Mapping Cardinality Constraints

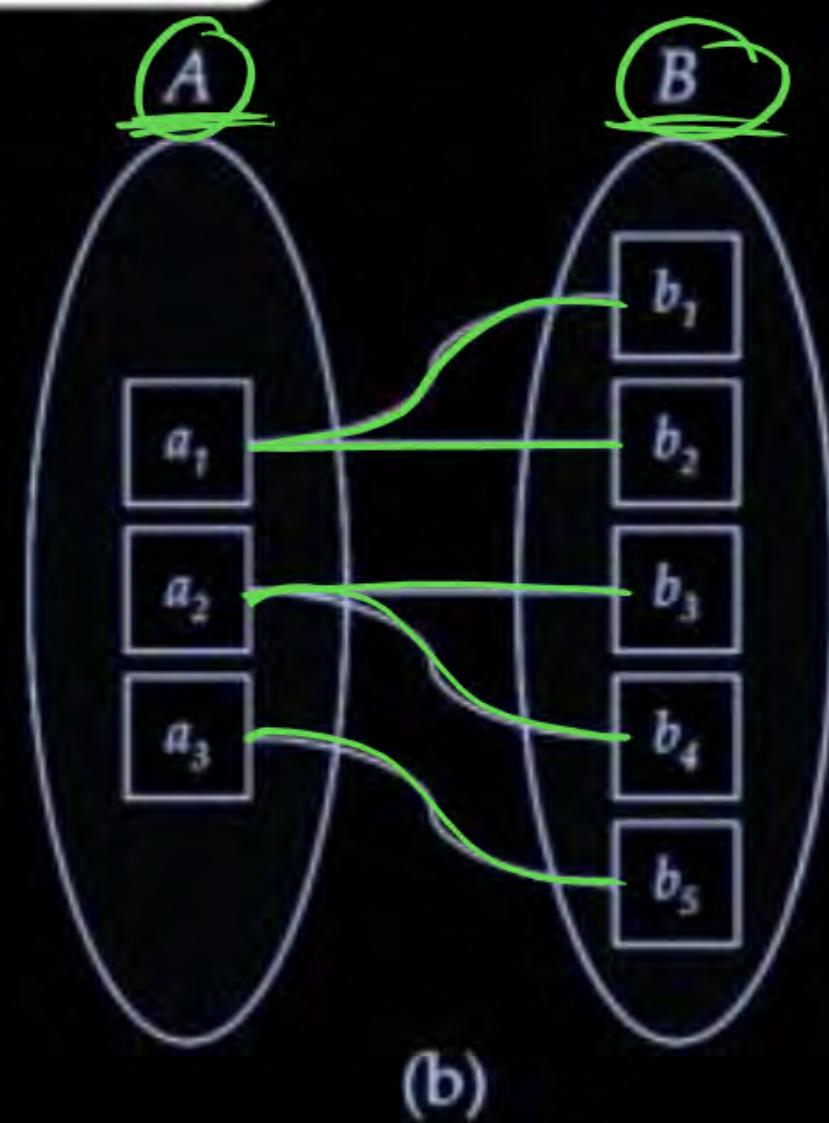
- Express the number of entities to which another entity can be associated via a relationship set.
- Most useful in describing binary relationship sets.
- For a binary relationship set the mapping cardinality must be one of the following types:
 - ① ✦ One to one ($1:1$)
 - ② ✦ One to many ($1:m$)
 - ③ ✦ Many to one ($M:1$)
 - ④ ✦ Many to many ($M:N$)



Mapping Cardinalities



(a)

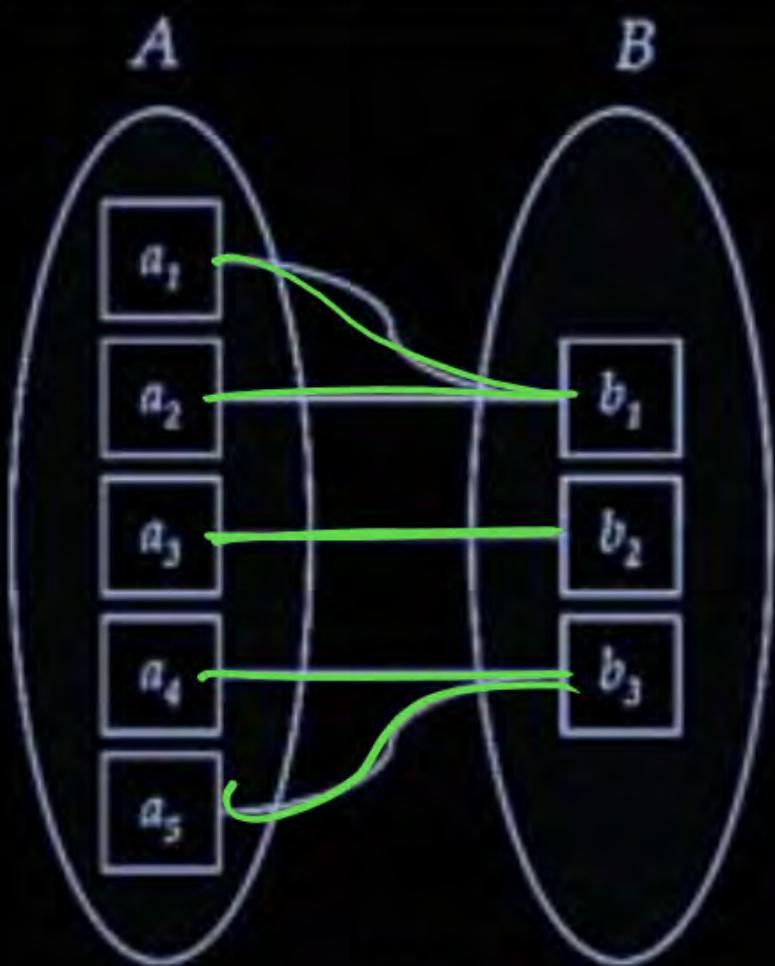


(b)

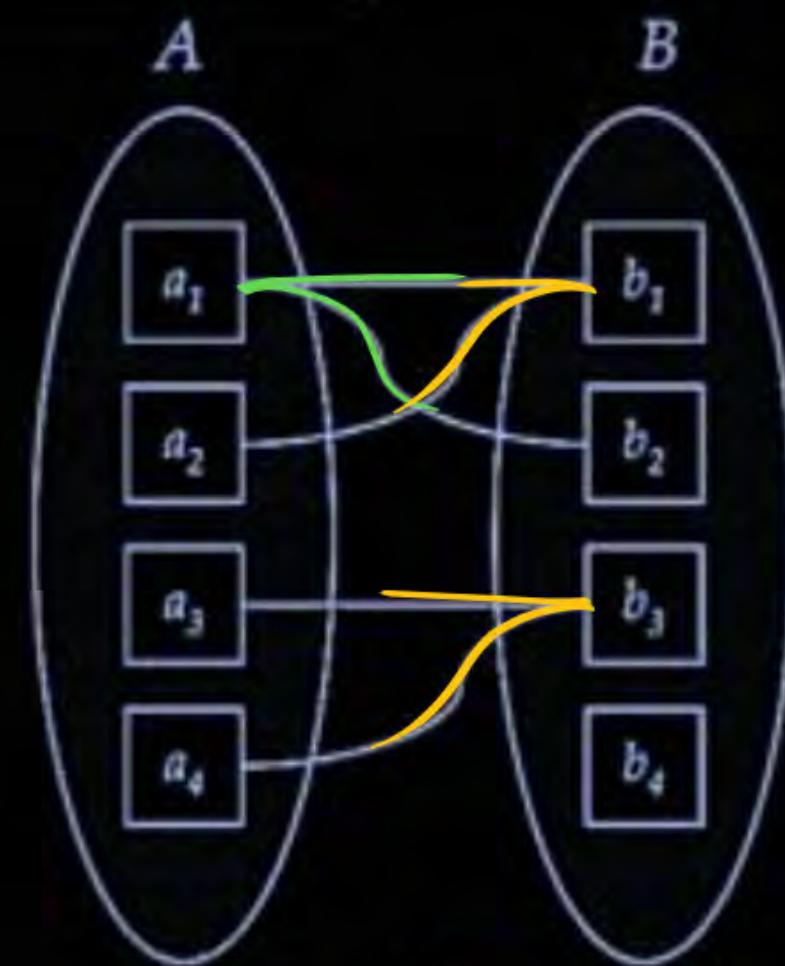
One to one

Note: Some elements in A and B may not be mapped to any elements in the other set.

Mapping Cardinalities



(a)

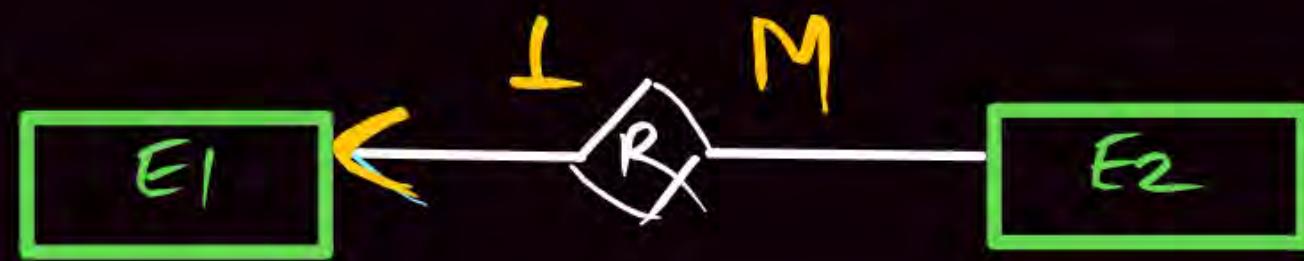


(b)

Many to
one

Many to many

Note: Some elements in A and B may not be mapped to any elements in the other set

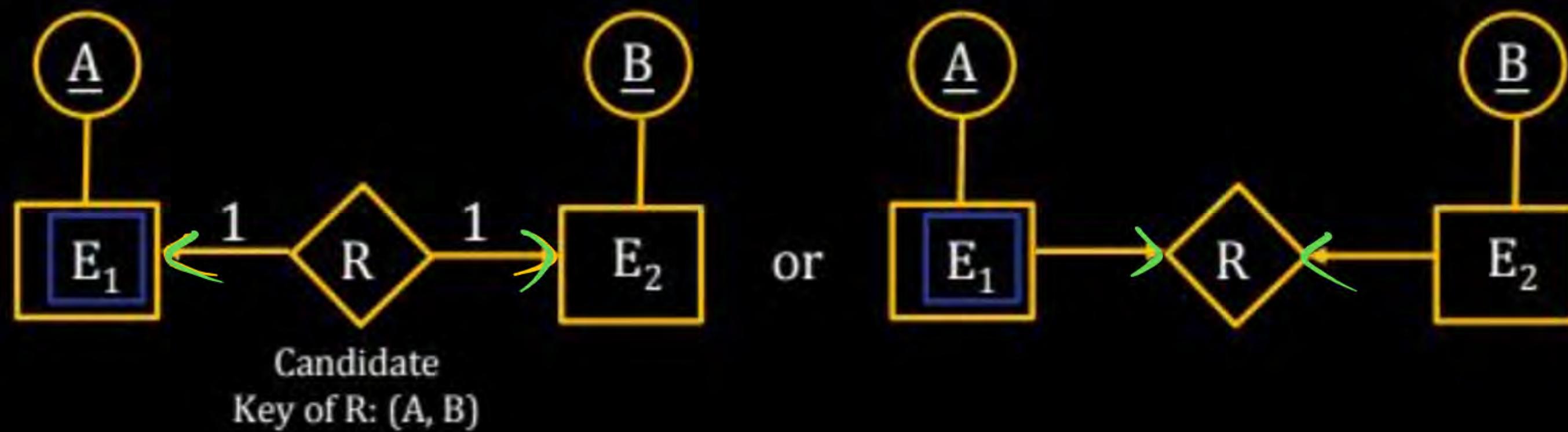


Mapping [Cardinality constraints of relationship set]

One mapping : At most one (0 or 1)

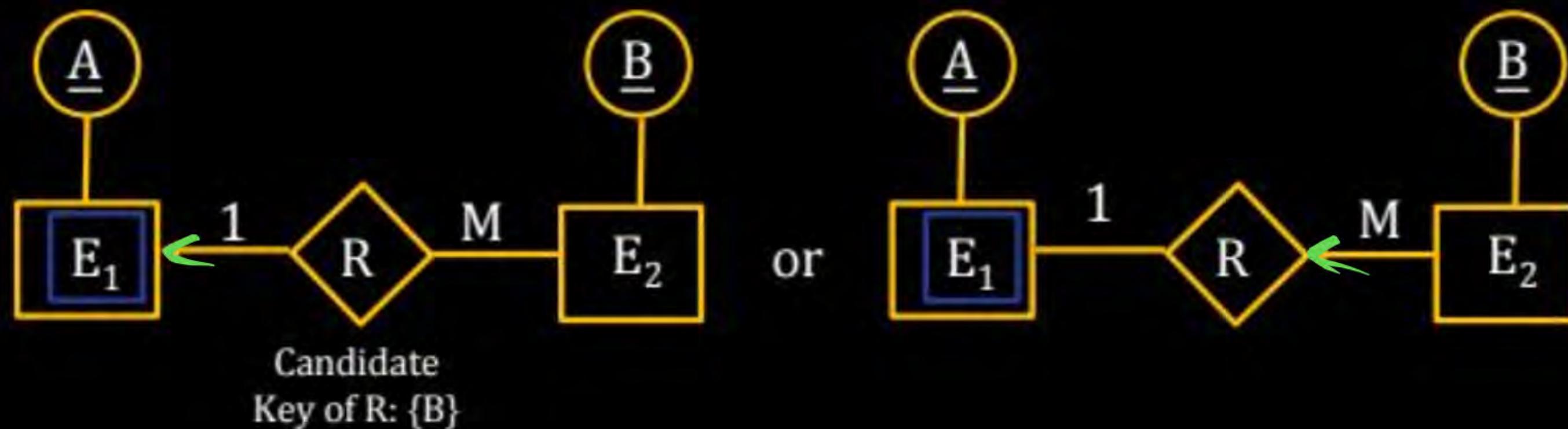
Many mapping : 0 or more (0 *)

Binary Relationship Mapping (One : One)



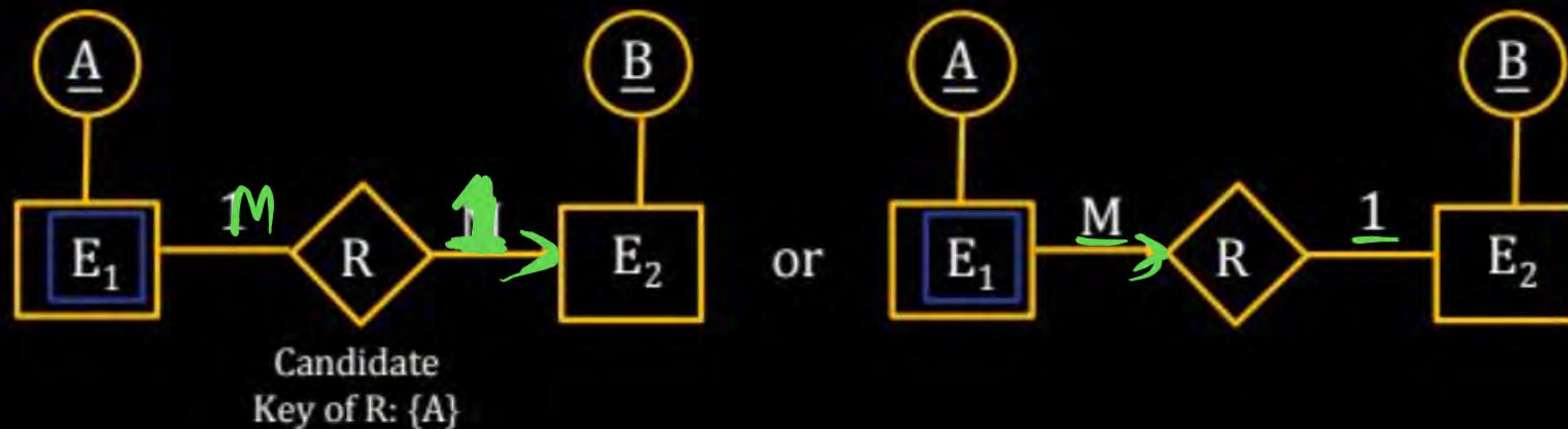
Mapping [Cardinality constraints of relationship set]

Binary Relationship Mapping (One : Many)



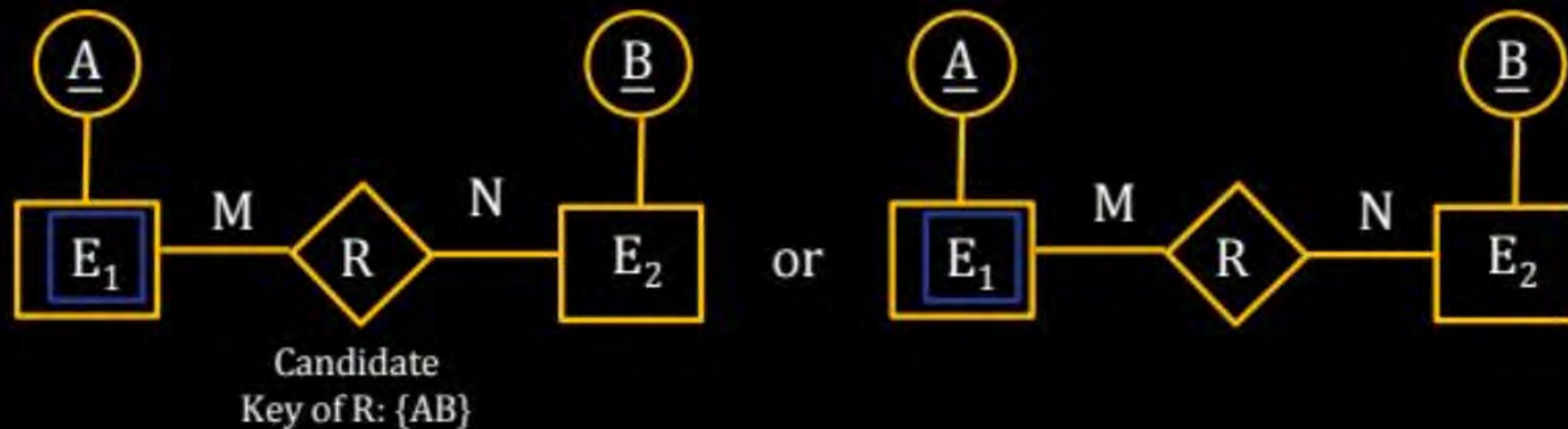
Mapping [Cardinality constraints of relationship set]

Binary Relationship Mapping (Many to One)



Mapping [Cardinality constraints of relationship set]

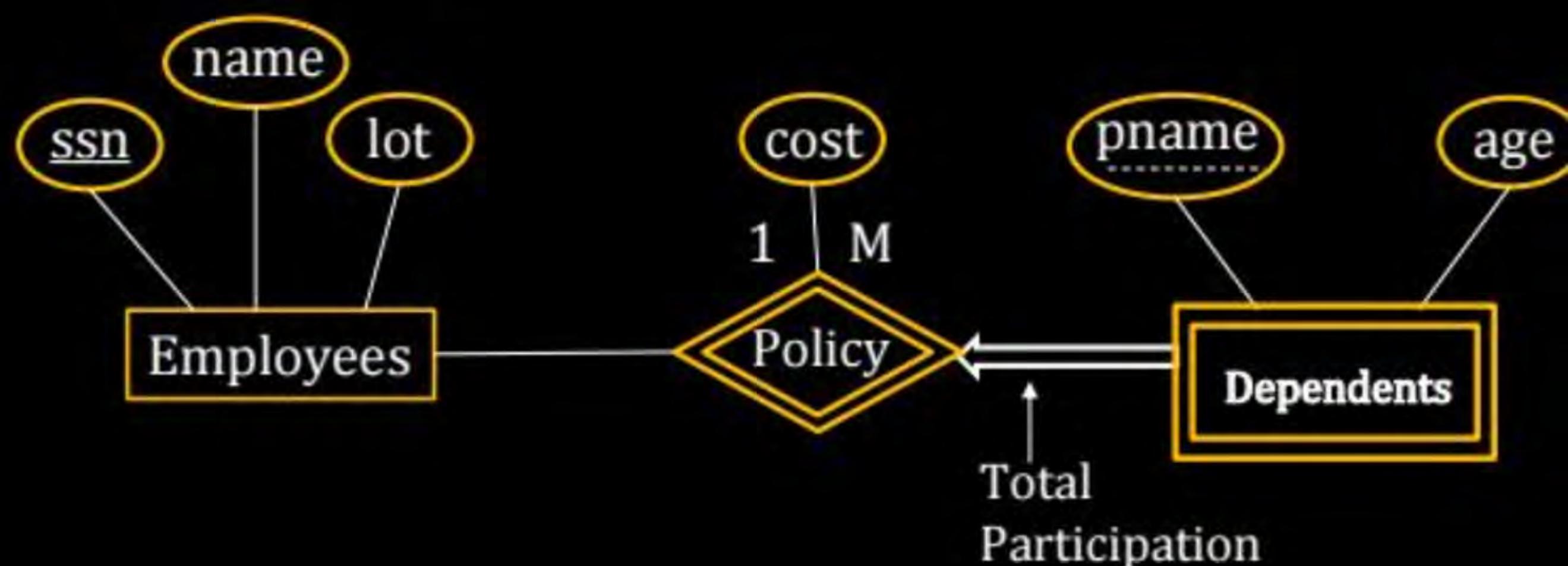
Binary Relationship Mapping (Many to Many)



Weak Entity Sets

- An entity that does not have a key attribute
- A weak entity must participate in an identifying relationship type with an owner or identifying entity type
- Entities are identified by the combination of:
 - ❖ A partial key of the weak entity type
 - ❖ The particular entity they are related to in the identifying entity type

- A weak entity can be identified uniquely only by considering the primary key of another (owner) entity.
- ❖ Owner entity set and weak entity set must participate in a one-to-many relationship set (one owner, many weak entities).
- ❖ Weak entity set must have total participation in this identifying relationship set.



Weak Entity Set and Weak Relationship Set

The entity set with no key. (Attributes of weak entity sets are not sufficient to differentiate entities uniquely).

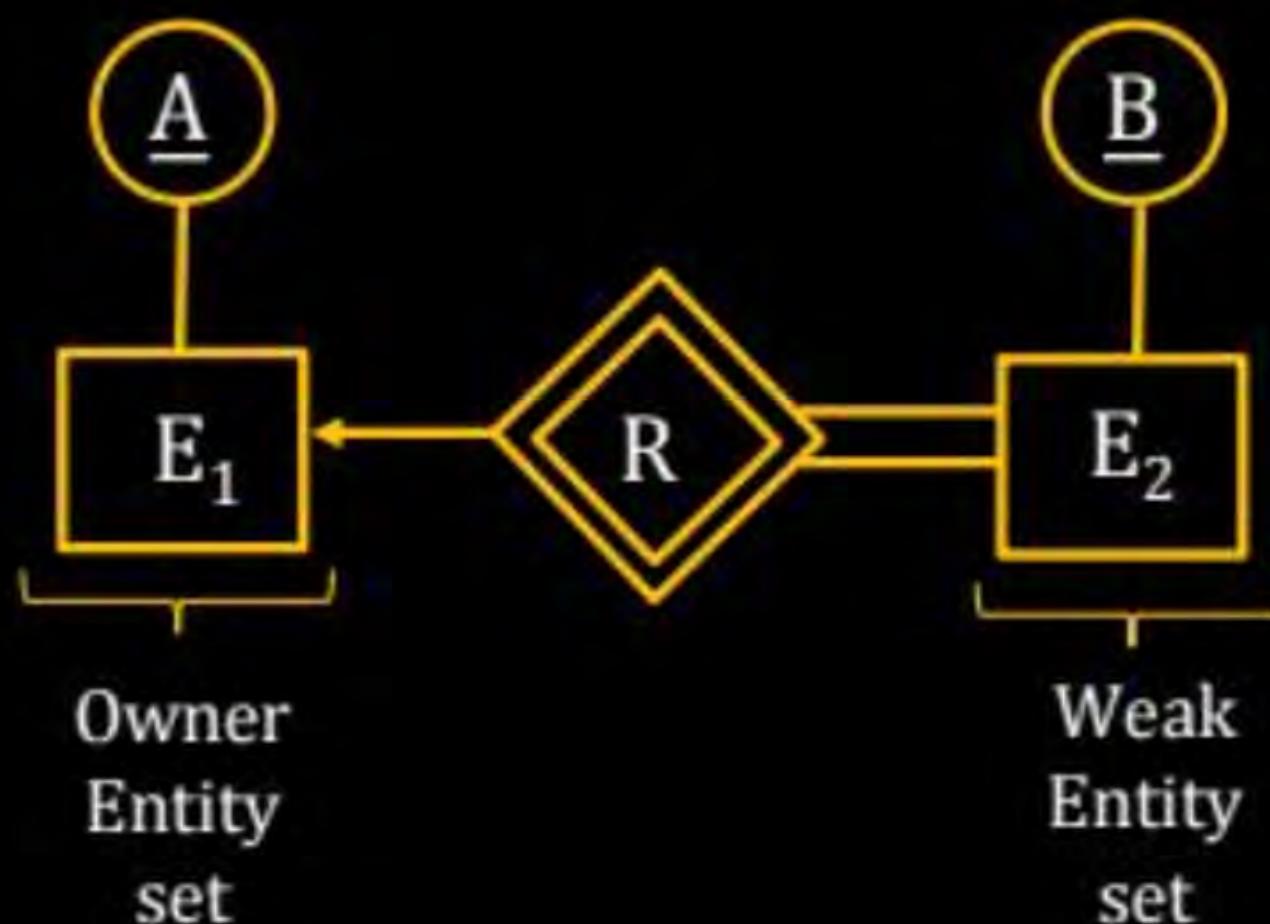


Points:

- (a) For each weak entity set there must be owner entity set, which is strong entity set.
- (b) Relationship set between weak entity set and identifier entity set is also “weak relationship set”.
- (c) The participation towards weak entity set end must be “total participation”.
- (d) The mapping between identifier entity set and weak entity set must be one : many (1 : M)

Weak Entity Set and Weak Relationship Set

Example:



NOTE:

Weak entity set and multivalued attributes allowed to represent in ER diagram but not allowed in RDBMS table.

Symbol**Meaning**

Entity



Weak Entity



Relationship



Identifying Relationship



Attribute



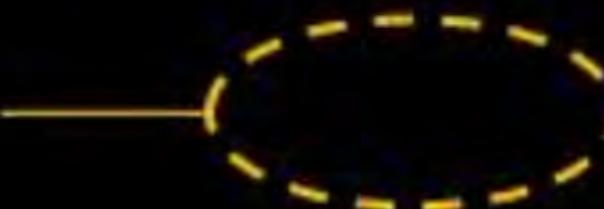
Key Attribute



Multivalued
Attribute



Composite
Attribute



Derived
Attribute

Symbol**Meaning**

Total Participation of E_2 in R



Cardinality Ratio 1:N for $E_1:E_2$ in R



Many - to- Many relationship



One - to - One relationship



Many - to - One relationship

Q.1 Given the basic ER and relational models,
which of the following is INCORRECT? [GATE-2012 : 1 Mark]

- A** An attribute of an entity can have more than one value.
- B** An attribute of an entity can be composite.
- C** In a row of a relational table, an attribute can have more than one value.
- D** In a row of a relational table, an attribute can have exactly one value or a NULL value.

Q.2

Which one of the following is used to represent the supporting many-one relationships of a weak entity set in an entity-relationship diagram? [2020:1 Mark]

- A** Rectangles with double/bold border
- B** Ovals with double/bold border
- C** Ovals that contain underlined identifiers
- D** Diamonds with double/bold border

ER to Relational Model Conversion

Q.

P
W

The term in list A have been mapped to list B so that is corresponds to the mapping process of ER MODEL into relational. Which of the following represent the mapping process?

[MCQ]

| List-A | List-B |
|--------------------------|---------------------------------------|
| A. Entity type | 1. Primary key (or alternate key) |
| B. Key attributes | 2. Child table |
| C. Composite attribute | 3. Set of simple component attributes |
| D. Multivalued attribute | 4. Relation |

A

A-3, B-1, C-4, D-2

B

A-4, B-1, C-3, D-2

C

A-3, B-2, C-2, D-4

D

A-4, B-1, C-2, D-3

(For binary relationship)

Partial participation on both side of binary relationship

- One to Many : Merge relationship set towards many side. So, 2 relational tables.
- Many to one : Merge relationship set towards many side. So, 2 relational tables.
- One to one : Merge relationship set any one side. So, 2 relational tables.
- Many to Many : Separate table for each entity set and relationship set. so, 3 relational tables.

Mapping [Cardinality constraints of relationship set]

(For binary relationship)

Full participation on “one” side of many to one relationship

Merge the entities and relationship set into single relational table. So, 1 table.



Mapping [Cardinality constraints of relationship set]



(For binary relationship)

Full participation on “Many” side of Many-to-one relationship

Merge relationship set towards many side. So, 2 relational tables.

Mapping [Cardinality constraints of relationship set]

(For binary relationship)

Full participation on any “one” side in one-to-one relationship

Merge the entity sets and relationship set into single table. So, 1 table.



Mapping [Cardinality constraints of relationship set]

(For binary relationship)

Full participation on any “Many” side of Many-to-Many relationship

Merge relationship set towards any “Many” side of relationship. So, 2 table.

Mapping [Cardinality constraints of relationship set]

(For binary relationship)

Full participation on both side of relationship

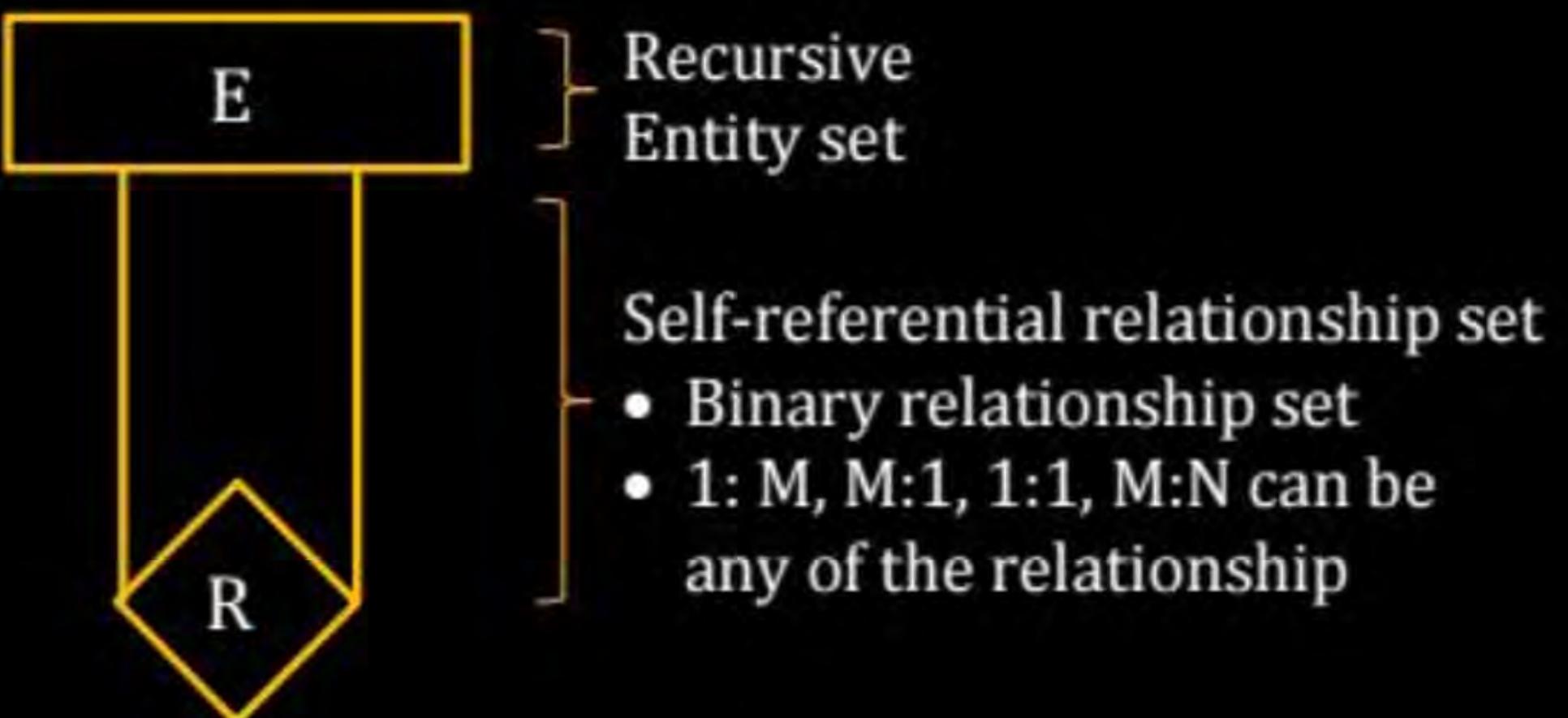
| | |
|-------|---|
| 1 : 1 | Merge the entity sets and Relationship into single Relational table so, 1 relational table. |
| 1 : M | |
| M : 1 | |
| M : N | |



Self-Referential Relationship Set

(Recursive entity set)

Entities of entity set (E) related to some other entity of same entity set (E).



Q.

Consider the following entity relationship diagram(ERD), where two entities E1 and E2 have a relation R of cardinality 1:m



The attributes of E1 are A11, A12 and A13 where A11 is the key attribute. The attributes of E2 are A21, A22, A23 where A21 is the key attribute and A23 is a multi-valued attribute. Relation R does not have any attribute. A relational database containing minimum number of tables with each tables satisfying the requirements of the third normal form (3NF) is designed from the above ERD. The number of tables in the database is

[GATE-2004 : 2 Marks]

A

2

B

3

C

5

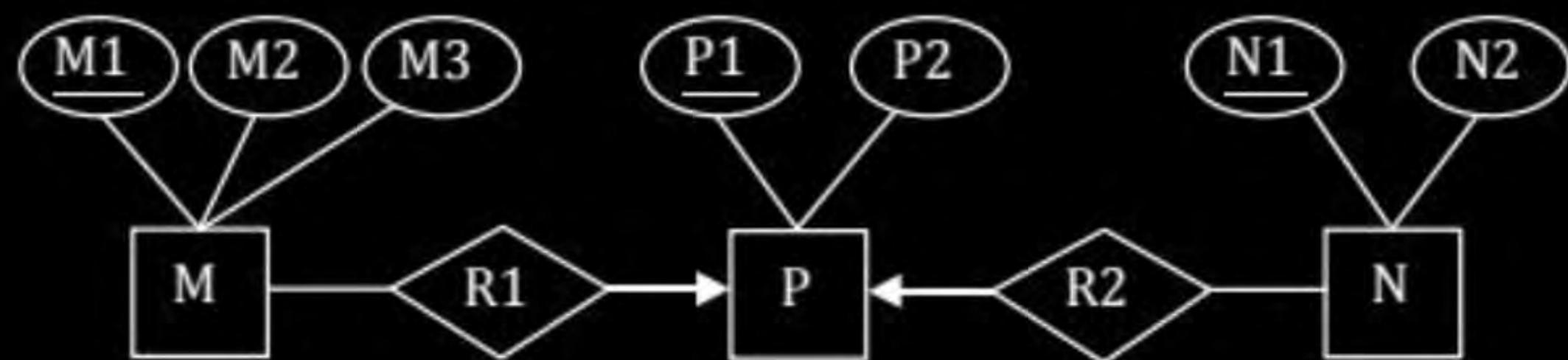
D

4

Q.

Common Data for Question

Consider the following ER Diagram



- (i) The minimum number of tables needed to represent **M**, **N**, **P**, **R1**, **R2** is
[GATE-2008 : 2 Marks]

A

2

B

3

C

4

D

5

(ii) Which of the following is a correct attribute set for one of the table for the correct answer to the above question?

GATE-2008 : 2 Marks]

- A {M1, M2, M3, P1}
- B {M1, P1, N1, N2}
- C {M1, P1, N1}
- D {M1, P1}

Referential Integrity Constraints

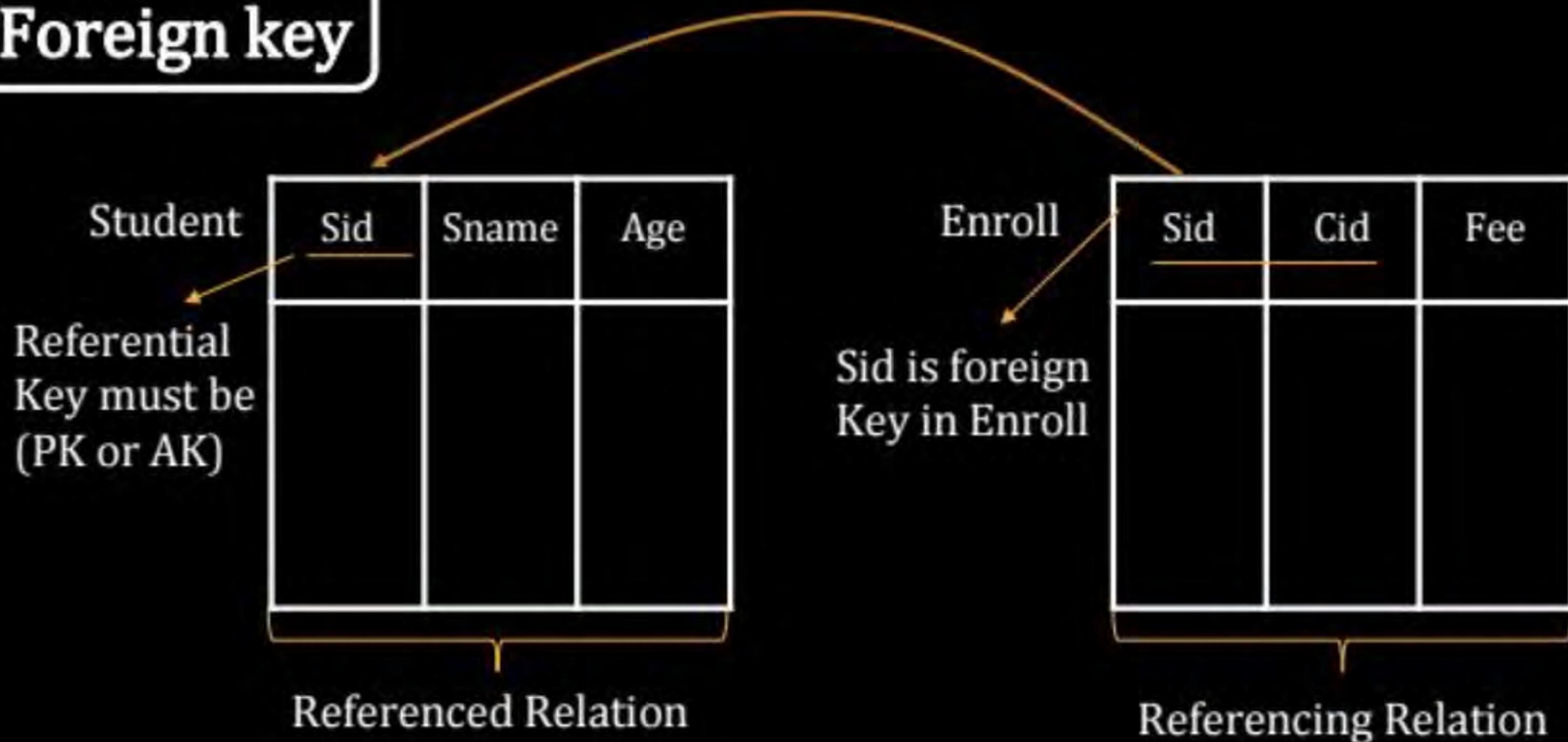


Foreign key

Foreign key is a set of attributes that references primary key or alternative key of the same relation or other relation.

Referential Integrity Constraints

Foreign key



Foreign Key

Foreign Key: is a set of Attribute reference to the primary key or alternative key of the same table or same other table.



It is used to relate or relation (table) with other or same relation (table)

Referencing Relation: Table which contain the foreign key is known as Referencing Relation [CHILD Relation].

Referenced Relation: Table which is referenced by foreign key is referenced relation.

Foreign Key Constraint

[Referential Integrity Constraint]

| STUDENT | | |
|----------------|----------------|-------|
| <u>Sid</u> | Sname | Login |
| S ₁ | A | -@ |
| S ₂ | A | --@ |
| S ₃ | B | ---@ |
| S ₄ | C ₁ | ----@ |

| Enrolled | | |
|----------------|----------------|------|
| <u>Sid</u> | <u>Cid</u> | Fees |
| S ₁ | C ₁ | 5K |
| S ₁ | C ₂ | 6K |
| S ₂ | C ₁ | 7K |
| S ₃ | C ₂ | 8K |

Sid of Enrolled table is the foreign key referencing to the primary key of student table.

[Sid: Primary Key]

Referenced Relation (Parent)

[Sid, Cid: Primary Key]

Referencing Relation (CHILD)

CREATE TABLE ENROLLED

Sid Varchar (10)

Cid Varchar (10)

Fees Integer (11)

Primary key (Sid Cid)

Foreign Key (Sid) Reference Student

→ By Default foreign key
Reference to Primary key.

When Sid is the primary key of Student

Let login is primary key & Sid is alternative key then

Foreign Key (Sid) Reference Student (Sid)

→ When Sid is not primary key.

Foreign Key Constraint

[Referential Integrity Constraint]

P → **Roll No** ← F.K

| STUDENT | | |
|----------------|------|--------|
| <u>Roll No</u> | Name | Branch |
| 1 | A | CSE |
| 2 | B | IT |
| 3 | C | CSE |

| Registration | | |
|--------------|-------|----------------|
| <u>CNo</u> | Cname | <u>Roll No</u> |
| 101 | DBMS | 1 |
| 102 | OS | 1 |
| 103 | CD | 3 |
| 104 | TOC | - |

Referenced Relation
(Parent)

Referencing Relation
(CHILD)

Foreign key



Referenced Relation

1. **Insertion** : No violation
2. **Deletion** : [May cause violation]
 - (a) **On delete no action** : Means if it cause problem on delete then deletion is not allowed on table.
 - (b) **On delete cascade** : If we want to delete primary key value from referenced table then it will delete that value from referencing table also.
 - (c) **On delete set null** : If we want to delete primary key value from referenced table then it will try to set the null values in place of that value in referencing table.

NOTE:

If foreign key field is not null attribute then “On delete set null” is same as “on delete no action.”

Foreign key



3. **Updation** : [May cause violation]

- (a) On update no action
- (b) On update cascade
- (c) On update set null

Referencing Relation

- 1. **Insertion** : [May cause violation]
- 2. **Deletion** : No violation
- 3. **Updation** : [May cause violation]

NOTE:

If integrity violation occurs because of insertion or updation in referencing table then restrict insertion and updation.

Example

| P.K | F.K |
|-----|-----|
| A | B |
| 2 | 4 |
| 3 | 4 |
| 4 | 5 |
| 5 | 4 |
| 6 | 2 |

B is foreign key
Referencing A,
Delete (2, 4) and
on delete cascade

| A | B |
|---|---|
| 3 | 4 |
| 4 | 5 |
| 5 | 4 |

Result

So, If we delete (2, 4) then PK "2". gets deleted from the table and all the tuples in which B is referencing PK.2" also gets deleted.

**THANK
YOU!**

