COMPUTER SCIENCE

Database Management System

ER Model

Lecture_1

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TOPICS TO BE COVERED
01
ER MODEL
02
Foreign Key Concepts

① FD & Normalization 3-4 Marks

② Transaction & Concurrency Control 2-3 Marks

③ ER Model & foreign key Concept (1-3 Marks)

④ Query Language.

⑤ File org & Indexing.

Entity – Relationship Model (Conceptual Design)

Entity : Object
- Physical : Book
- Logical : Account

Entity Set : Collection of similar entity.

Entity

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

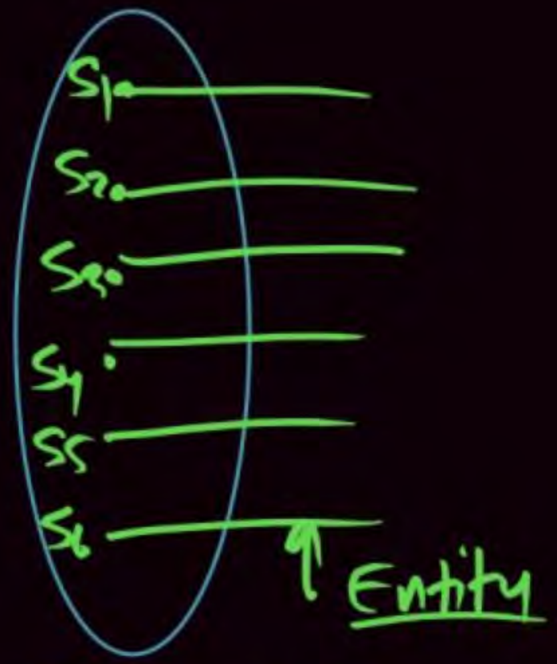
- Example: Specific person

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

STUDENT set : Entity set



STUDENT
Entity Set

Entity Set → STUDENT

Entity Set ← STUDENT (Roll No Name Gender)

Entity →

1	Ajay	Male
2	Seema	Female
3	Vasudev	Male
4	Mudit	Male
5	Neha	Female

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

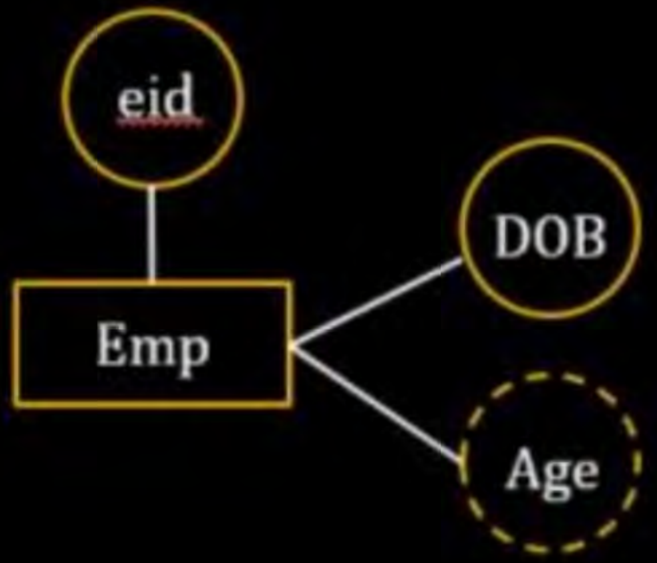
student

Entity 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:



(verb) Relationship :

Relationship set :

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 ≥ 2 entities, each taken from entity sets

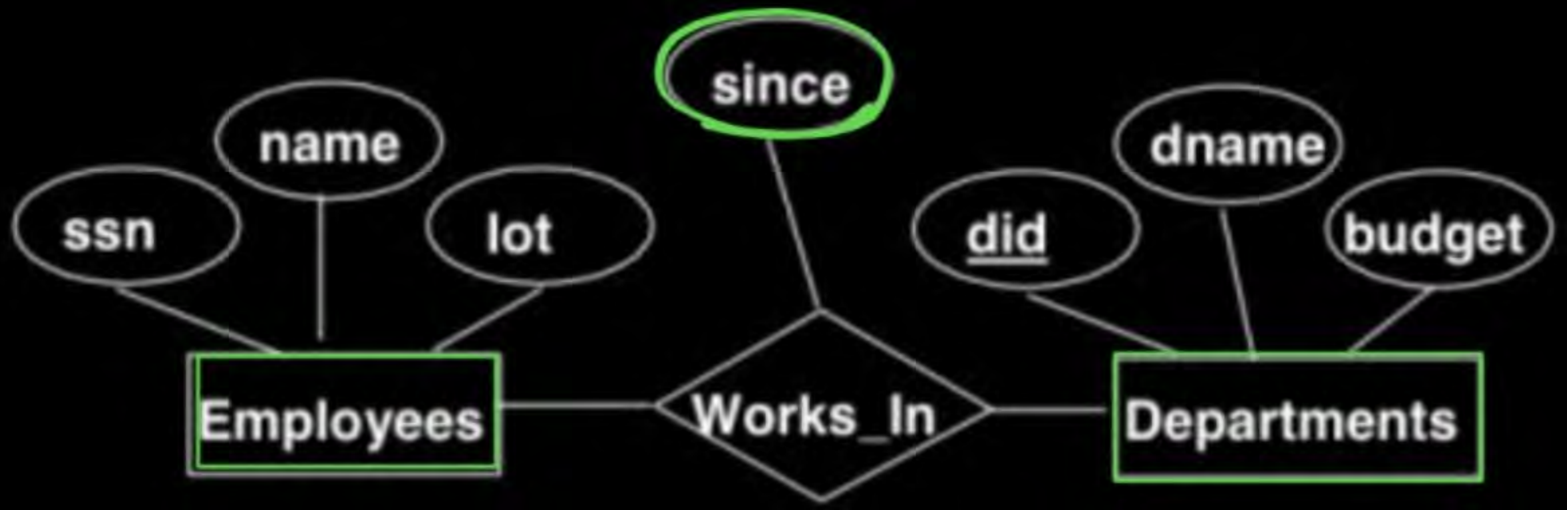
  $\{(e_1, e_2, \ldots e_n) \mid e_1 \in E_1, e_2 \in E_2, \ldots, e_n \in E_n\}$

  where $(e_1, e_2, \ldots, e_n)$ is a relationship
  - Example:

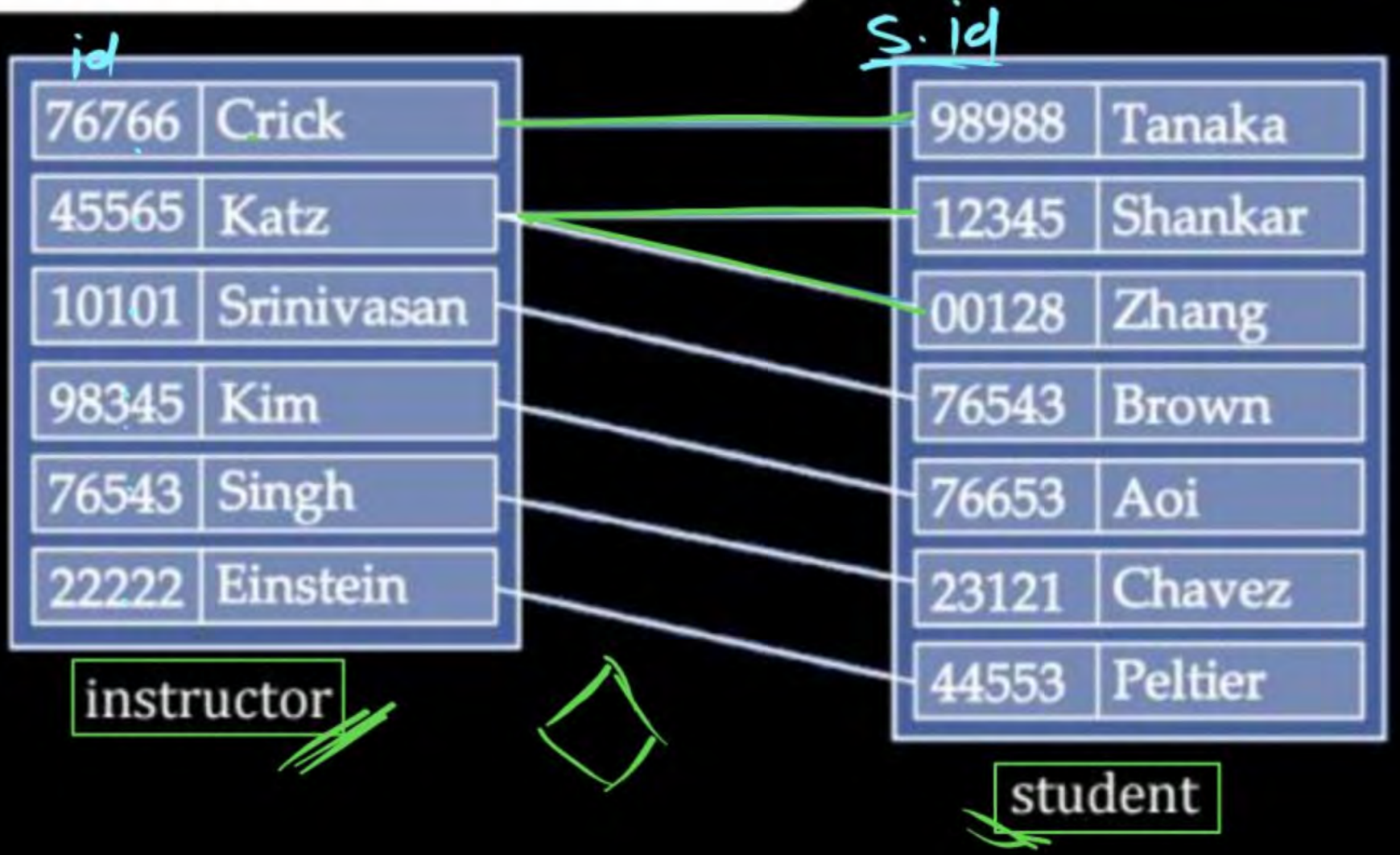
    (44553, 22222) ∈ advisor or

Relationship Sets

- Collection of similar relationships.

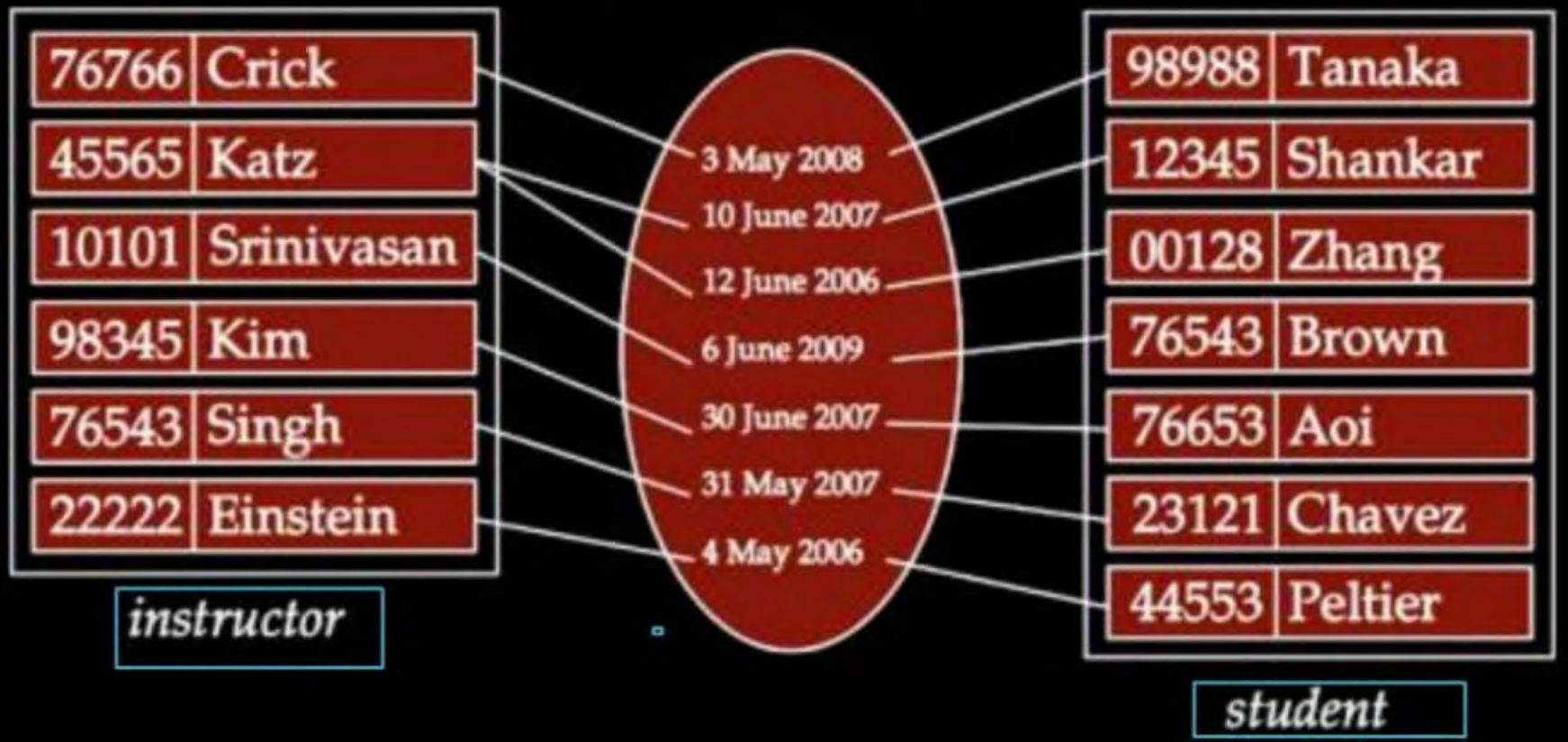


Relationship Set advisor



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



① Entity

Collection

Entity Set

Relationship

Set

Relationship set

A_1 Teching B_1

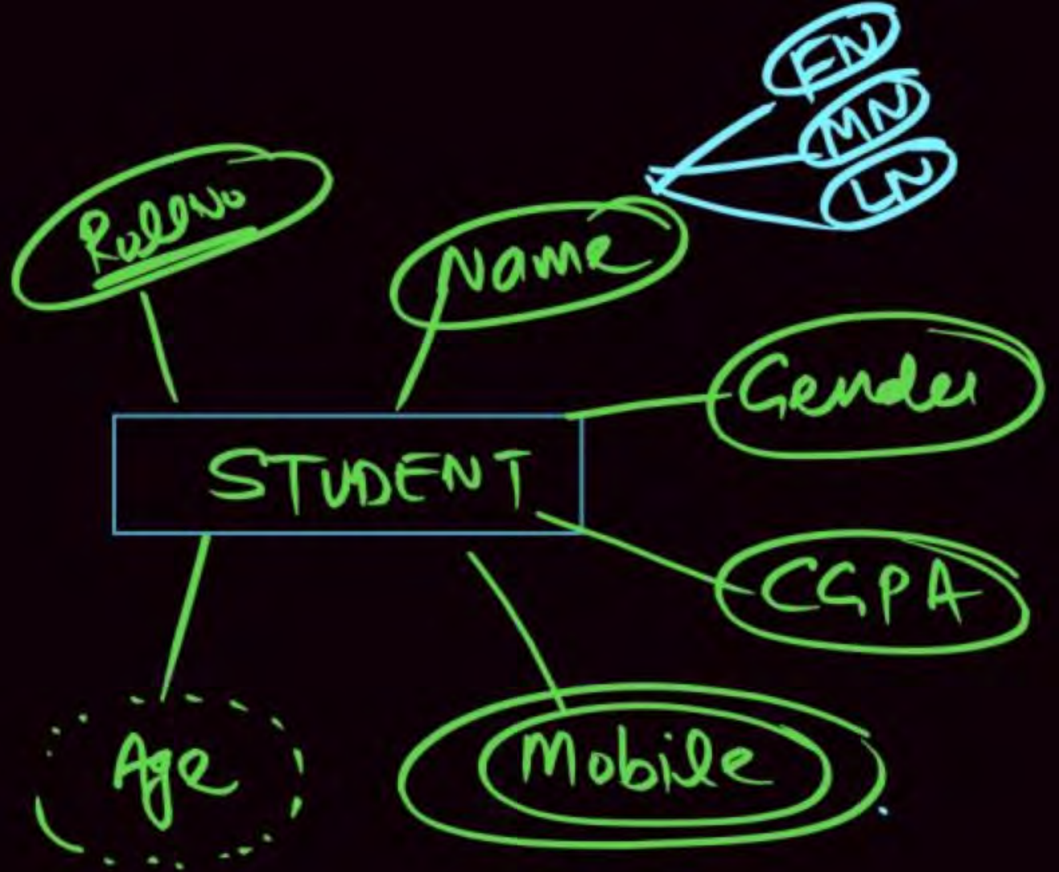
A_2 Teaching B_2

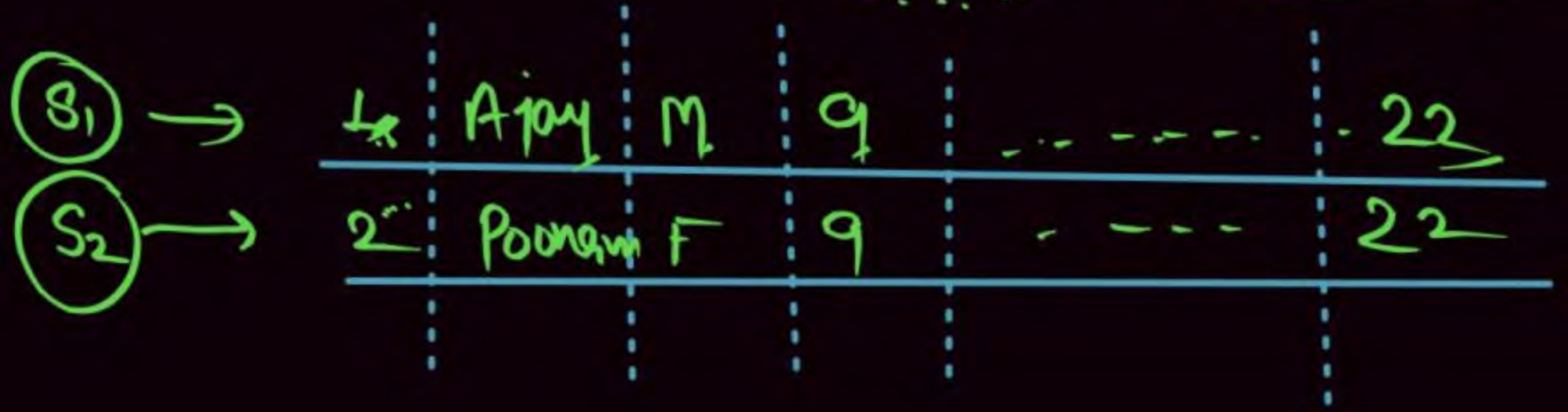
Entity → 'object'

Entity Set → Collection of Similar entity

Attribute :


STUDENT


FN
MN
LN
RollNo
Name
Gender
STUDENT
CGPA
Age
Mobile


S_1
S_2
1
Ajay
M
9
22
2
Poonam
F
9
22

Attributes

Attributes are properties used to describe an entity. of the Entity Set.

Attribute types:

(1) Simple and composite attributes.

(2) Single-valued and multivalued attributes

(3) Stored and Derived attributes

(4) key attribute

(5) Complex Attribute

(1) Simple & Composite Attribute:

Which Cannot be divided further.

- Roll No
- Gender

Which can be divide further.

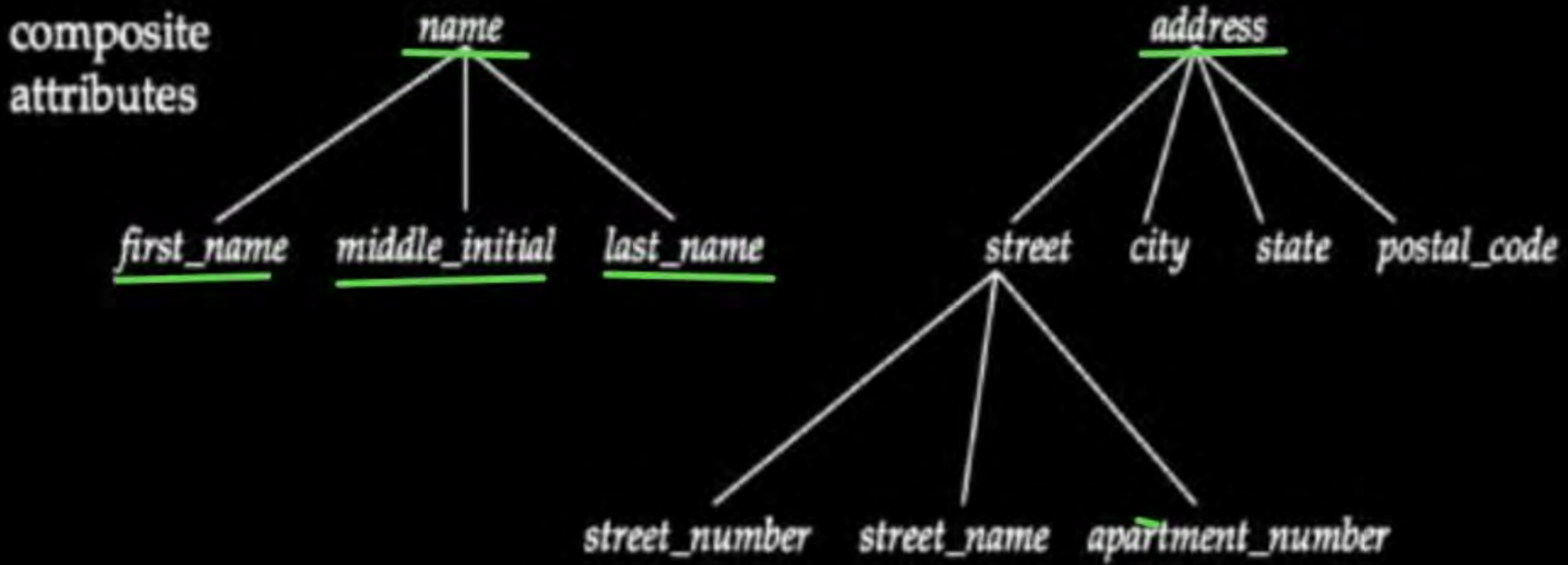
1) Simple & Composite attribute

1. Simple

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

2. 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.

Multivalued Attribute: Which takes More than One Value Per entity.

Multivalued Attribute.

3) Stored and Derived attributes

Stored Attribute: Which does not Require Any Update.

eg D.O.B [Date of Birth]

Derived Attribute: The value of an attribute derived from other Attribute.

eg 

D.O.B : 07-07-2014

In
2023 : 9 years.
2024 : 10 year.
2034 : 20 year
2054 : 40 year.

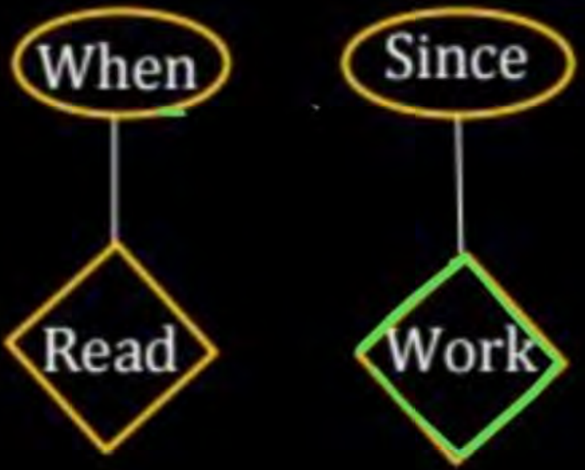
4) Key and Descriptive attributes

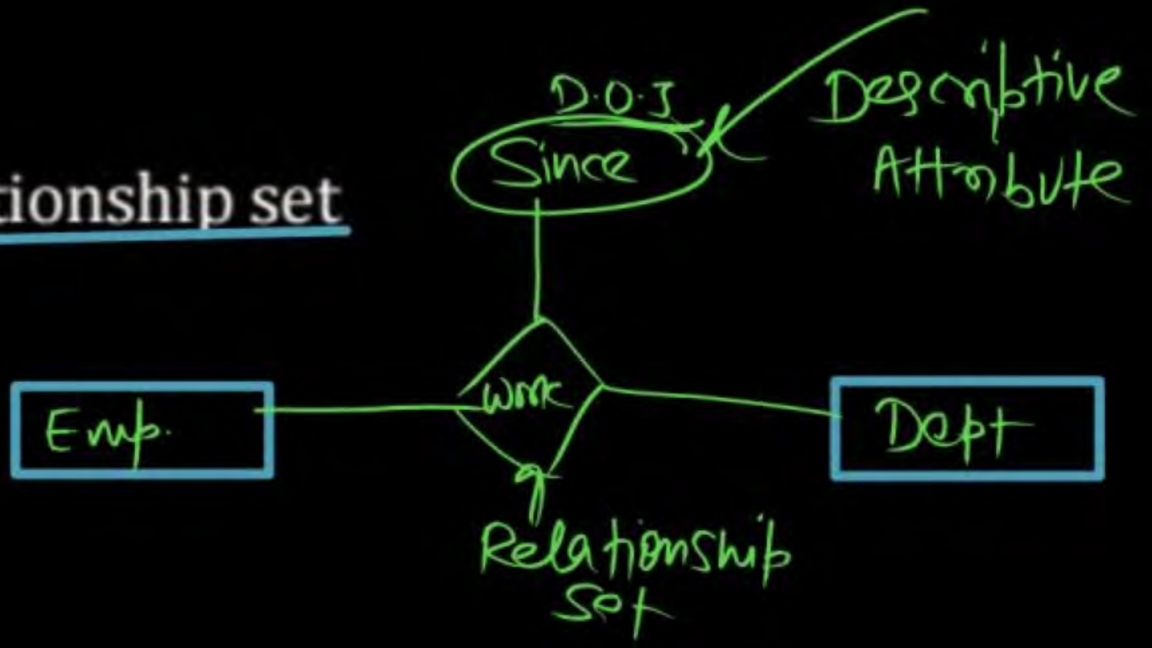
Key Attribute:

Which uniquely Identify an entity in the entity set.

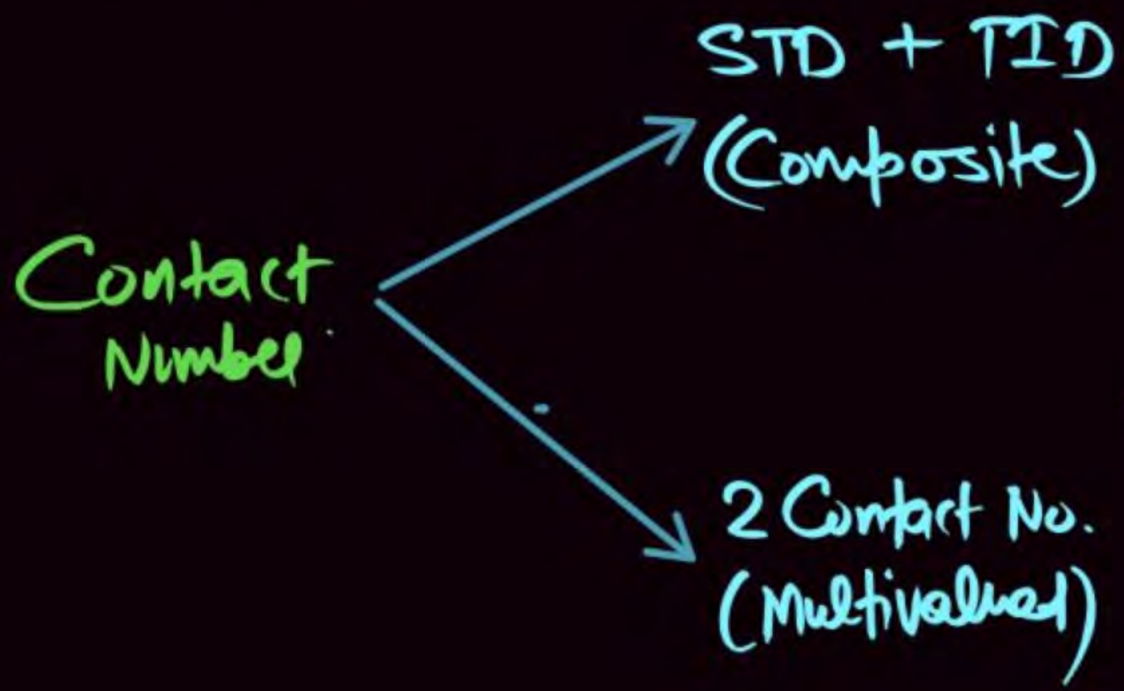
Descriptive Attribute:

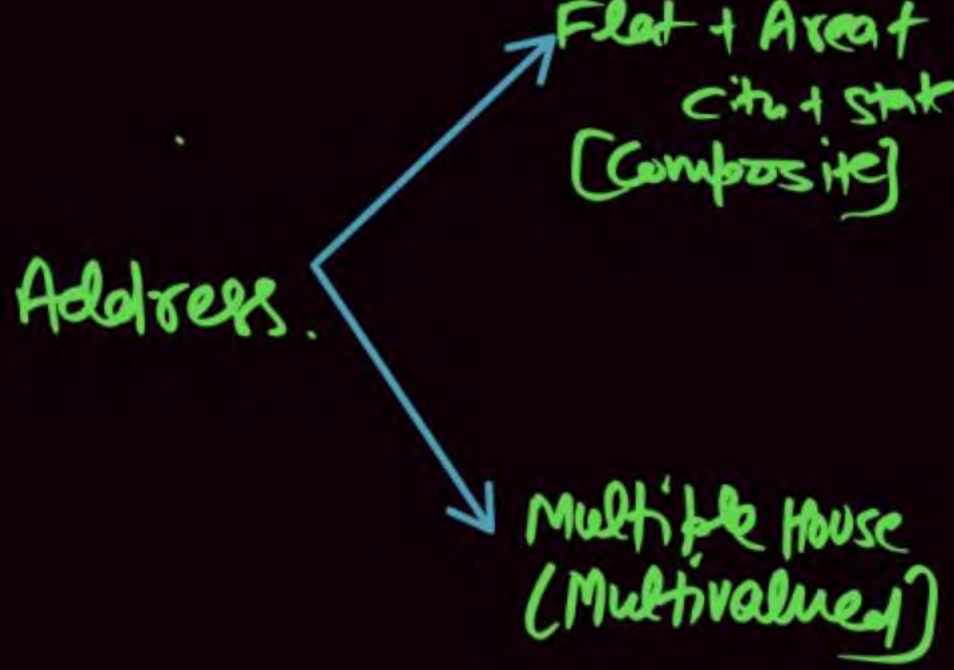
Which gives information about the relationship set

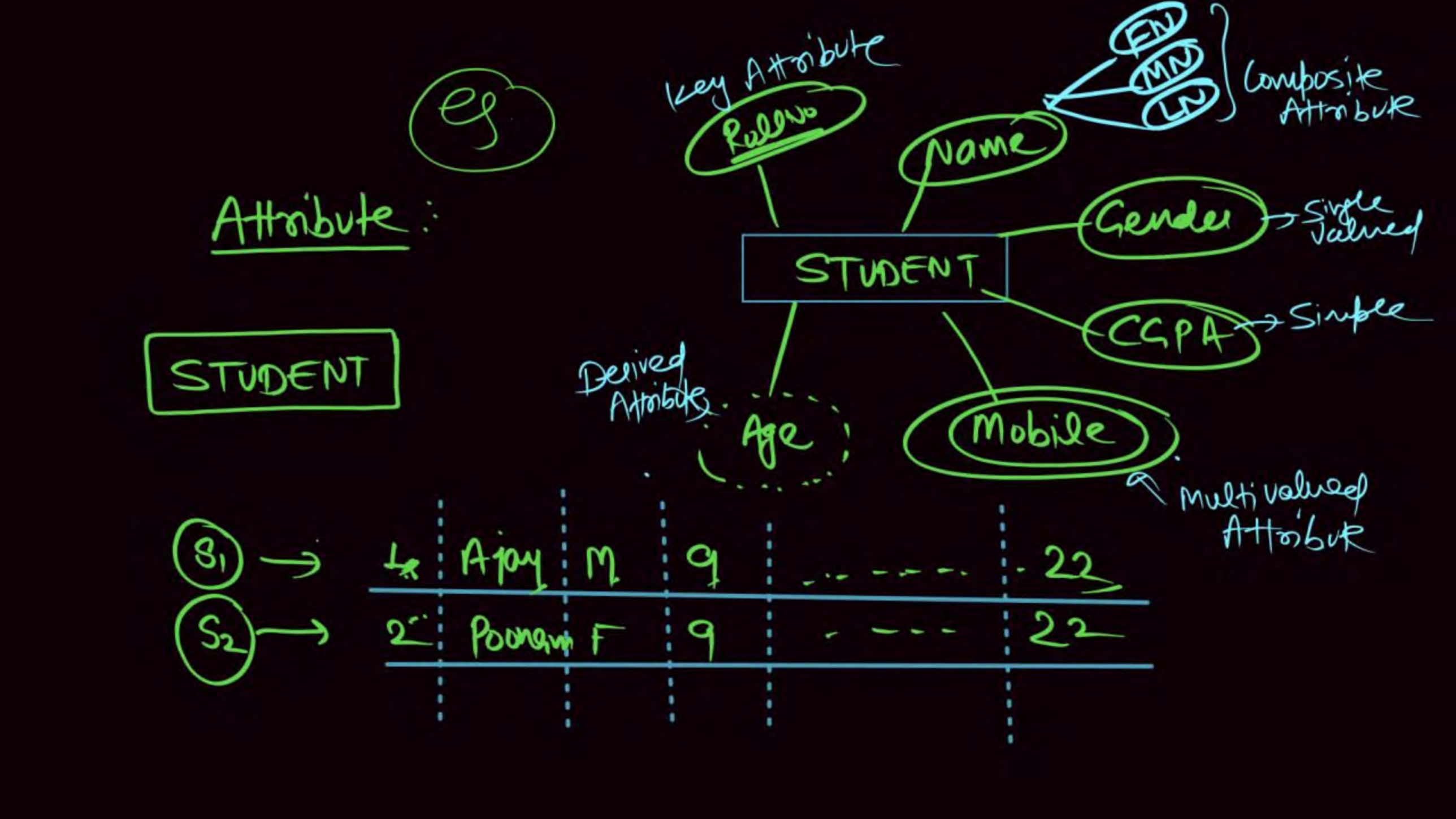




⑤ Complex Attribute : Composite + Multivalued Attribute.






eg
Attribute :
STUDENT
Key Attribute
RollNo
Name
FN
MN
LN
Composite Attribute
Gender
Single Valued
CGPA
Simple
Derived Attribute
Age
Mobile
Multi valued Attribute
S1
S2
1
Ajay
M
9
22
2
Poonam
F
9
22

1. Entity & Entity Set
2. Relationship & Relationship Set
3. Attribute & its types
   - (i) Simple & Composite
   - (ii) Single valued & Multivalued
   - (iii) Stored & Derived Attribute
   - (iv) Key & Descriptive Attribute
   - (v) Complex Attribute

Degree of Relationship Set :

↓

How many Number of Entity Set are Participating.

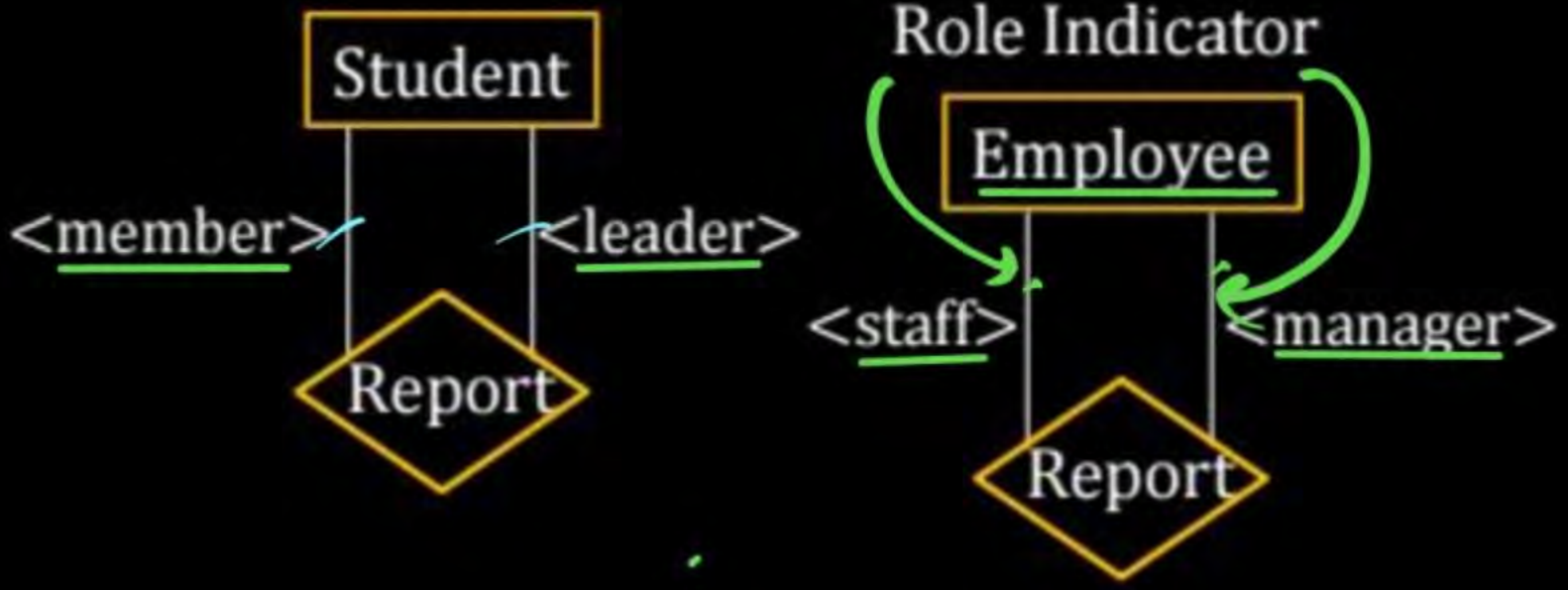
1. Unary (One Entity Set)
2. Binary (2 Entity Set)
3. Ternary (3 Entity Set
4. N-ary (n Entity Set

} Participate

Degree of Relationship Set

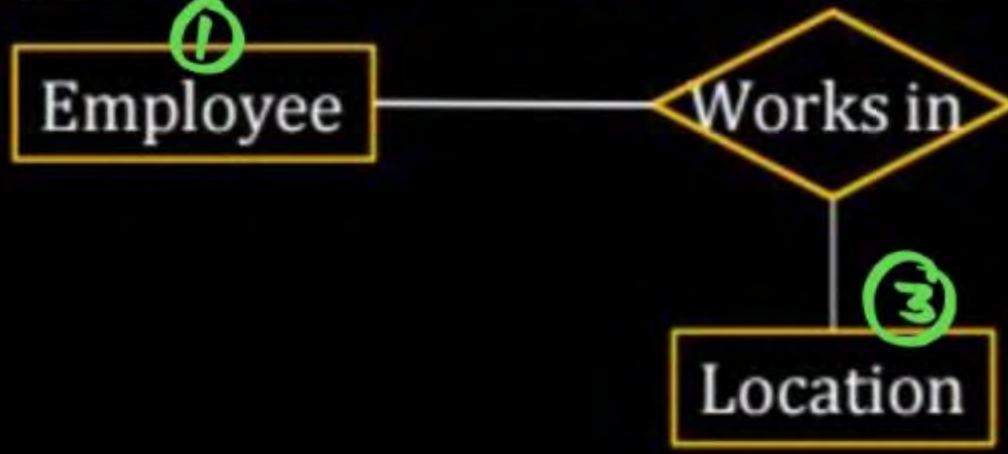
Degree of Relationship Set: Specifies the numbers of Entity set participate in a relationship set

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

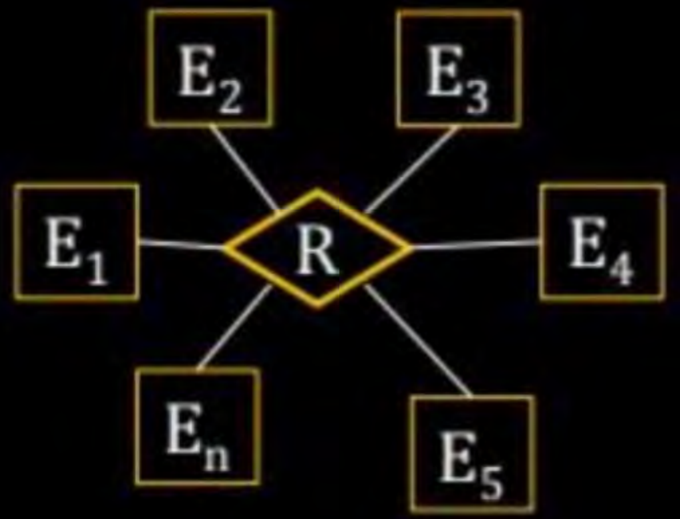


2) Binary Relationship: The relationship among two entity set

3) Ternary Relationship: The relationship among three entity set

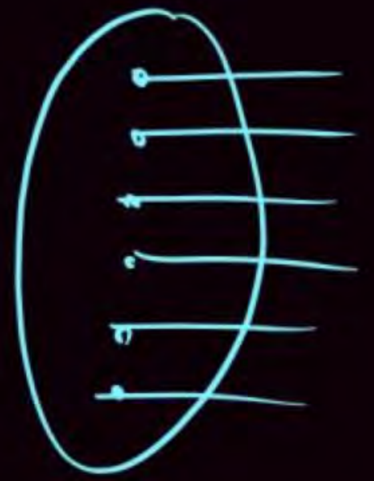


4) n-ary Relationship:
The relationship among n-entity set



Participation Constraint :

- Total Participation (=) Double Line
- Partial Participation (—) Single Line



E1

Total Participation

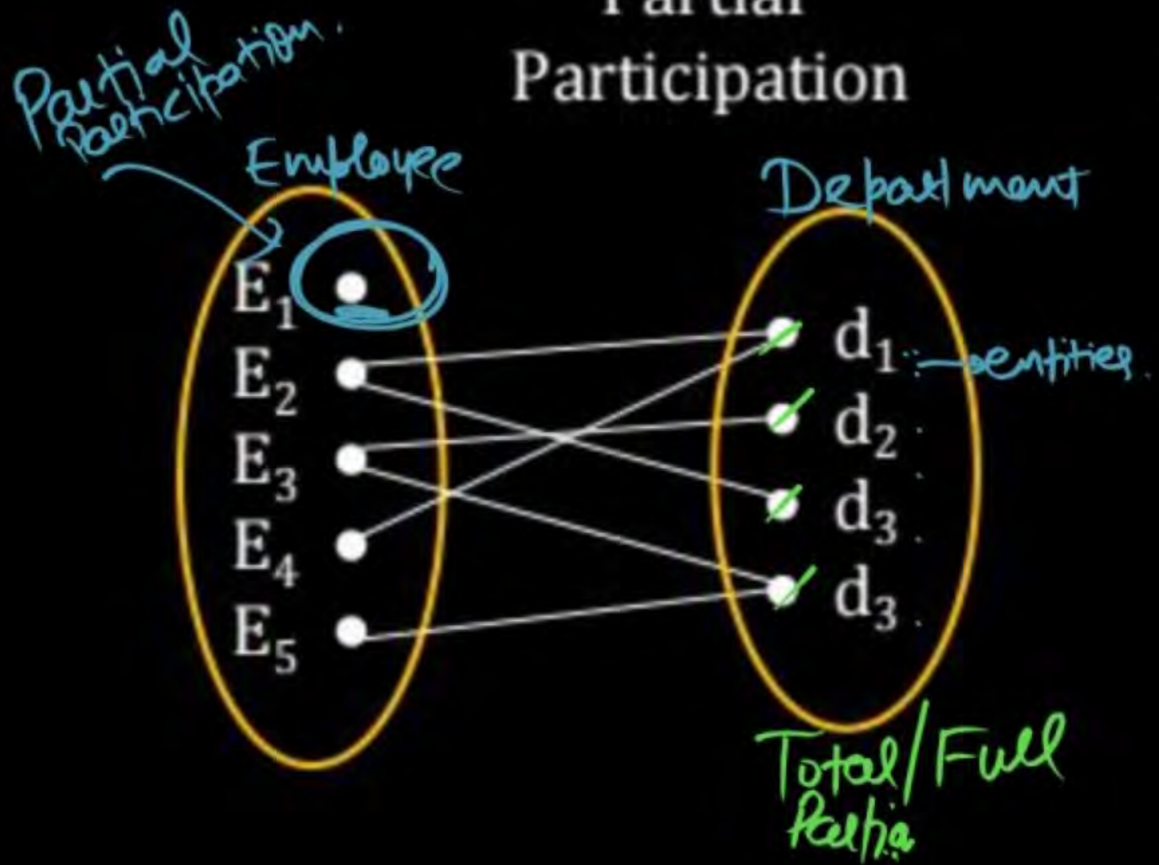
E2

Partial Participation

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



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.

① Degree of Relationship : # Entity Set are participating.

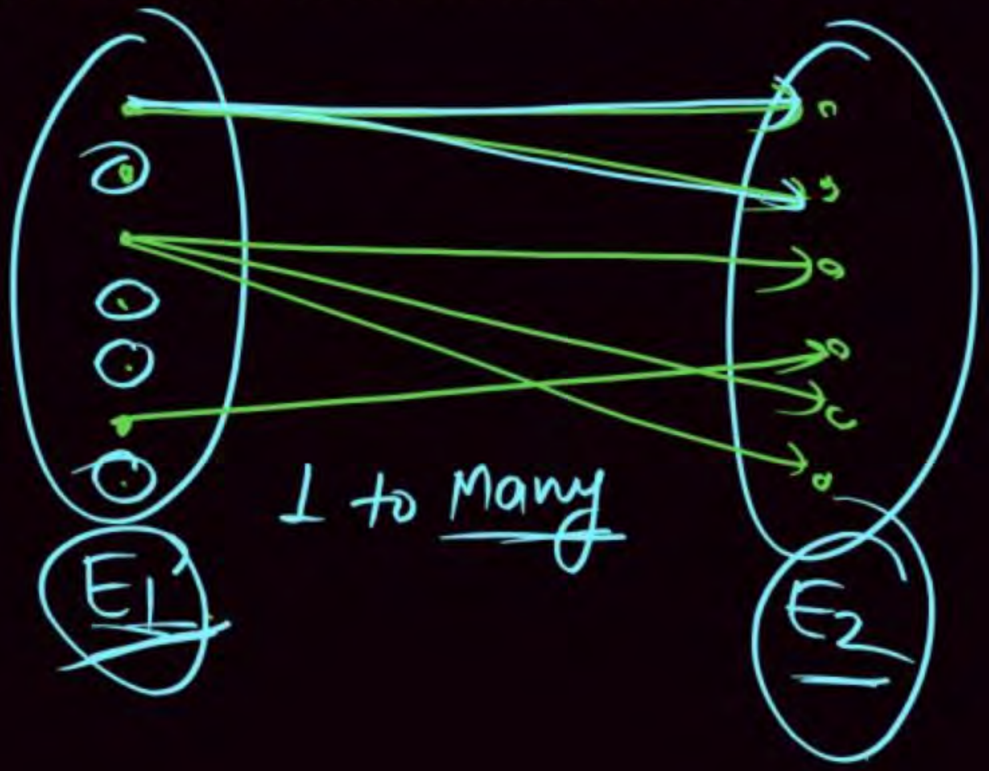
② Mapping : # Entities

eg

Degree = 2
[2 Entity set]

Total participation : E_2 Side

Cardinality : 1 to Many

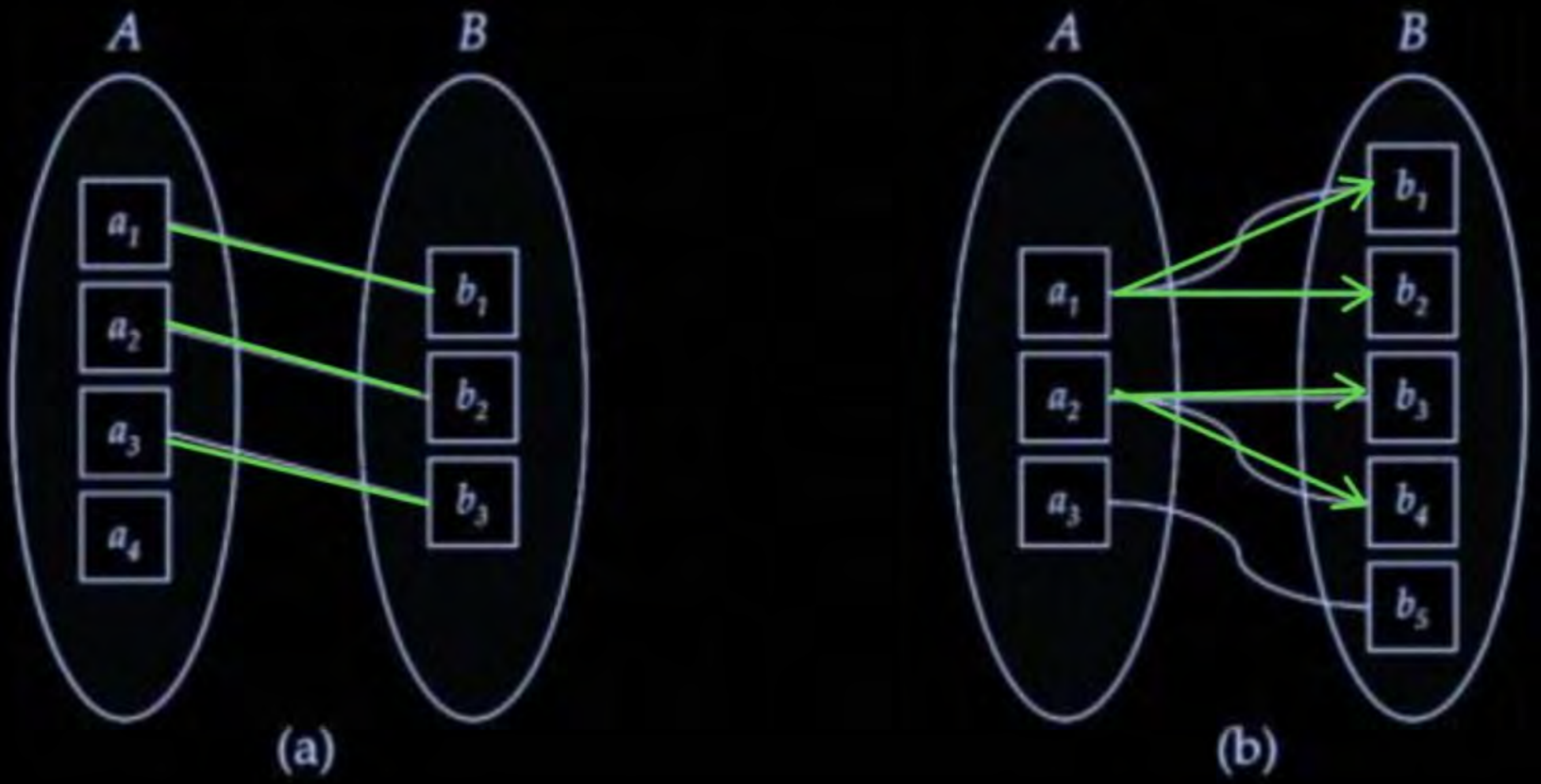


Mapping Cardinality Constraints

- 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

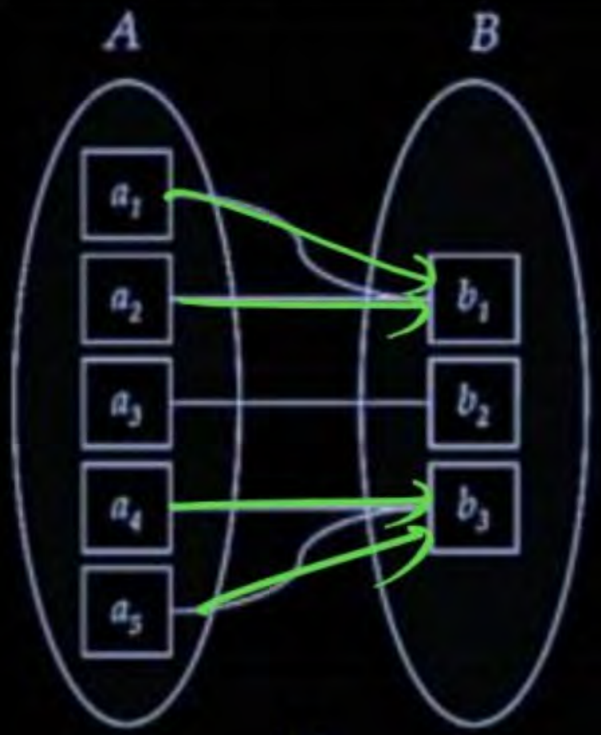


One to one

One to many

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

Mapping Cardinalities



(a)

Many to one

(b)

Many to many

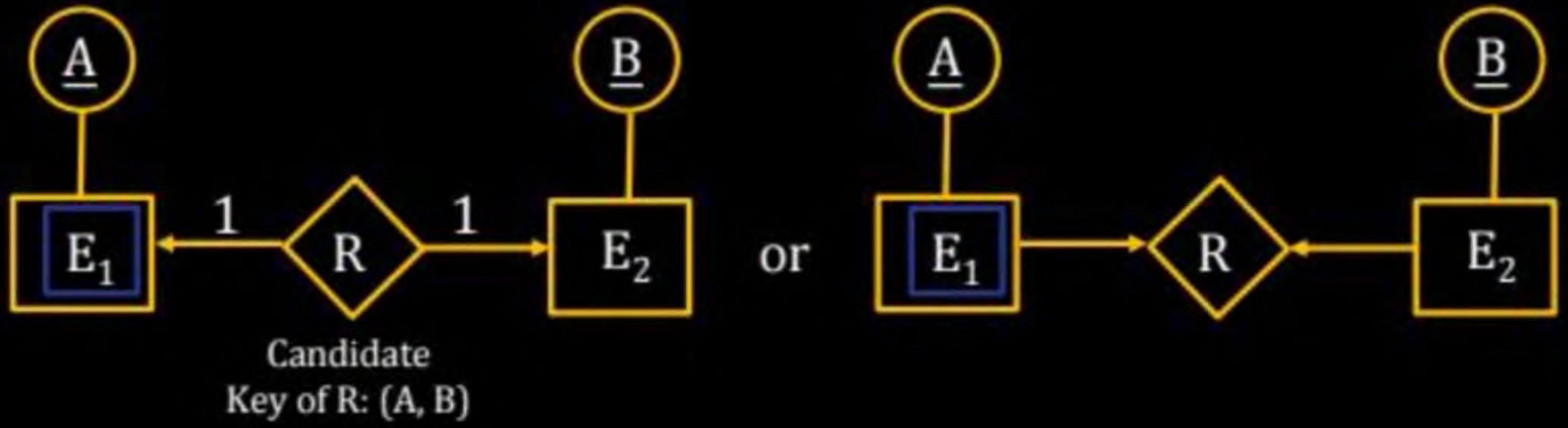
Note: Some elements in A and B may not be mapped to any elements in the other set

Mapping [Cardinality constraints of relationship set]

One mapping : At most one (0 or 1)

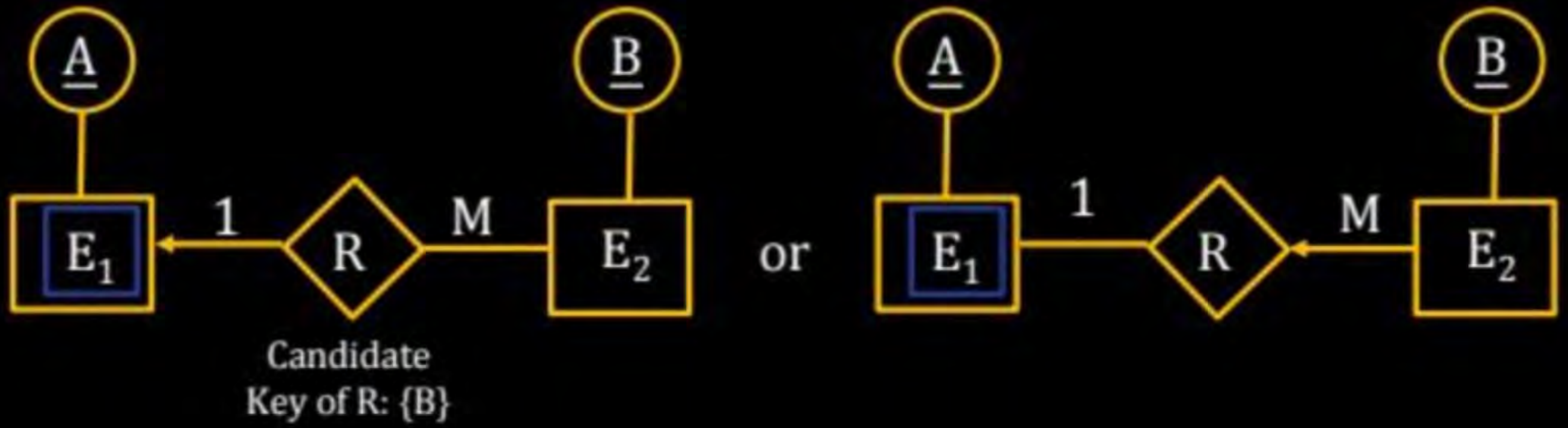
Many mapping : 0 or more (0 ..... *)

Binary Relationship Mapping (One : One)



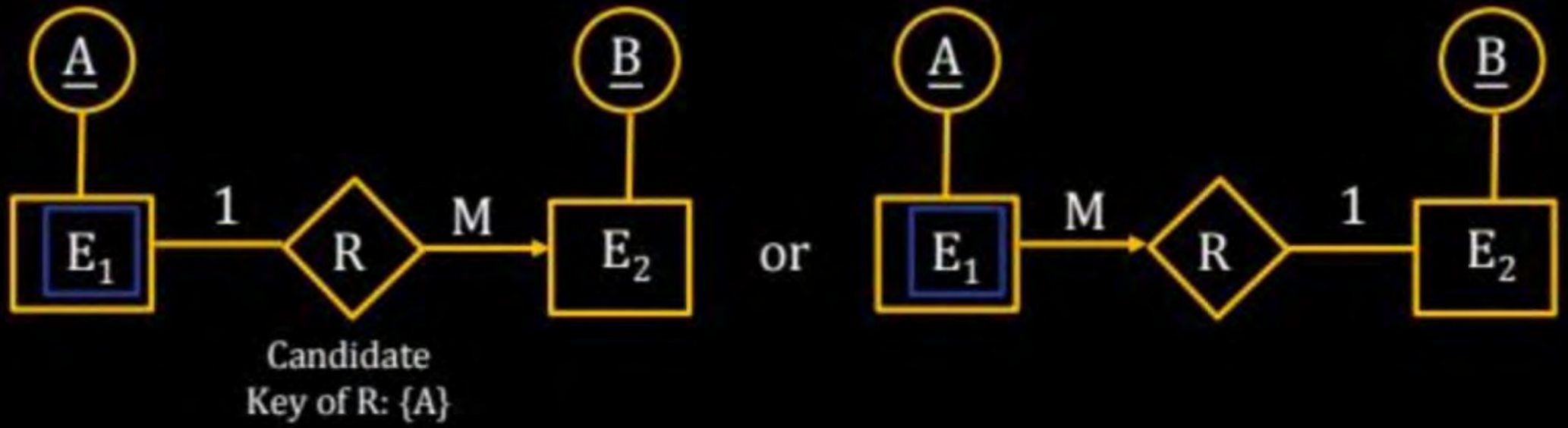
Mapping [Cardinality constraints of relationship set]

Binary Relationship Mapping (One : Many)



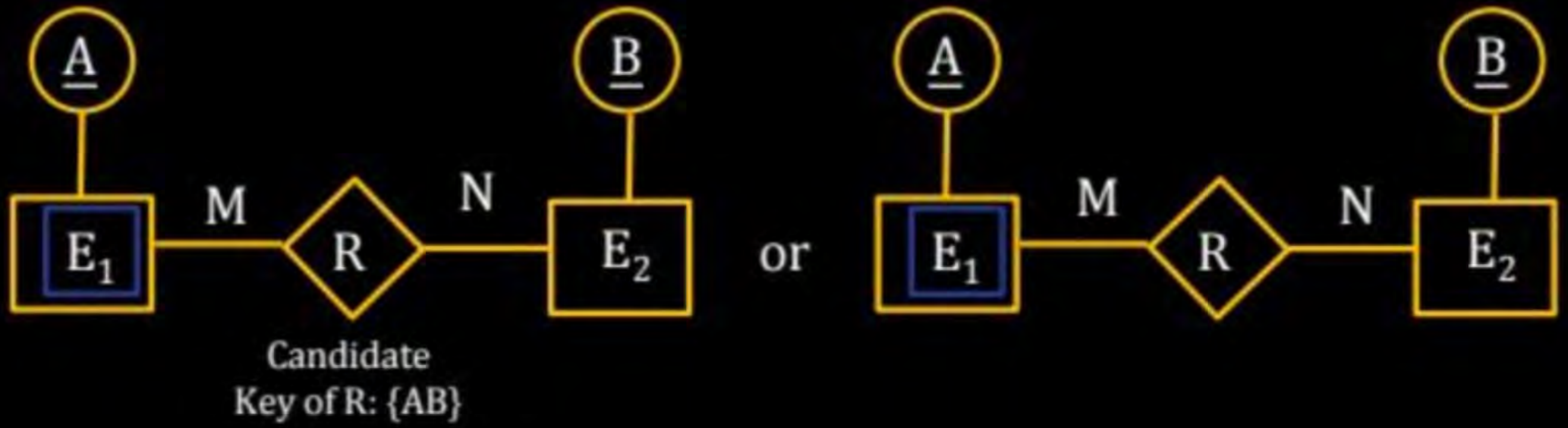
Mapping [Cardinality constraints of relationship set]

Binary Relationship Mapping (Many to One)



Mapping [Cardinality constraints of relationship set]

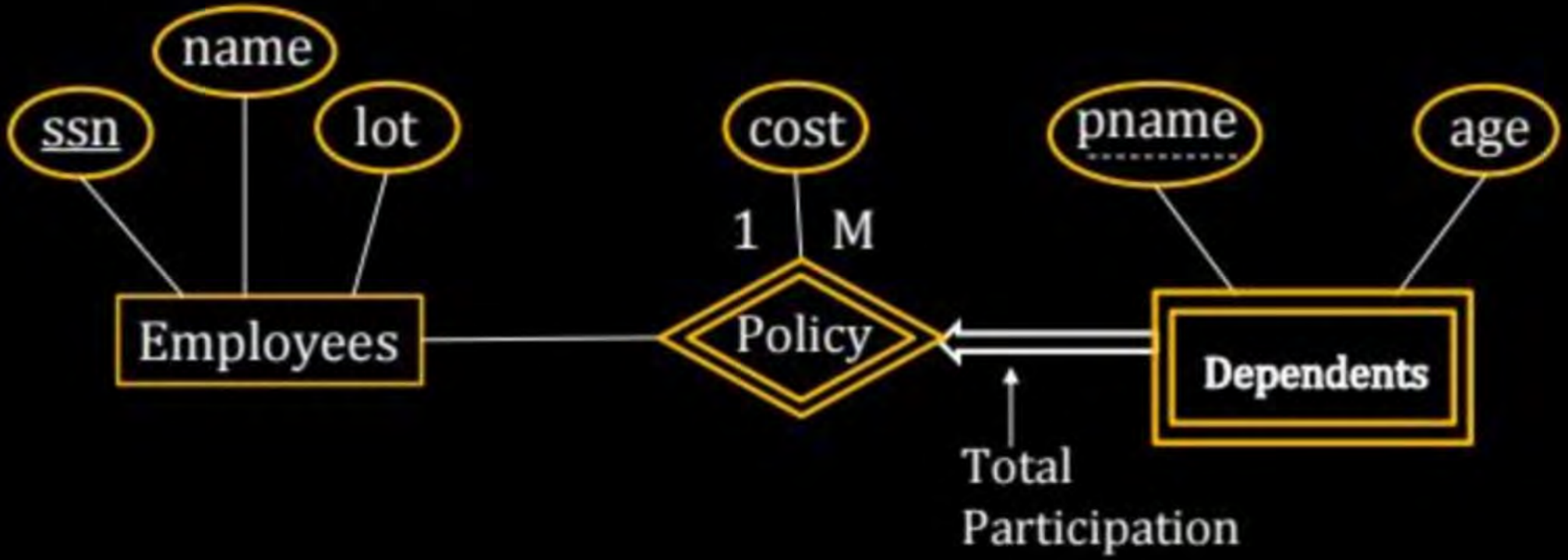
Binary Relationship Mapping (Many to Many)



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.

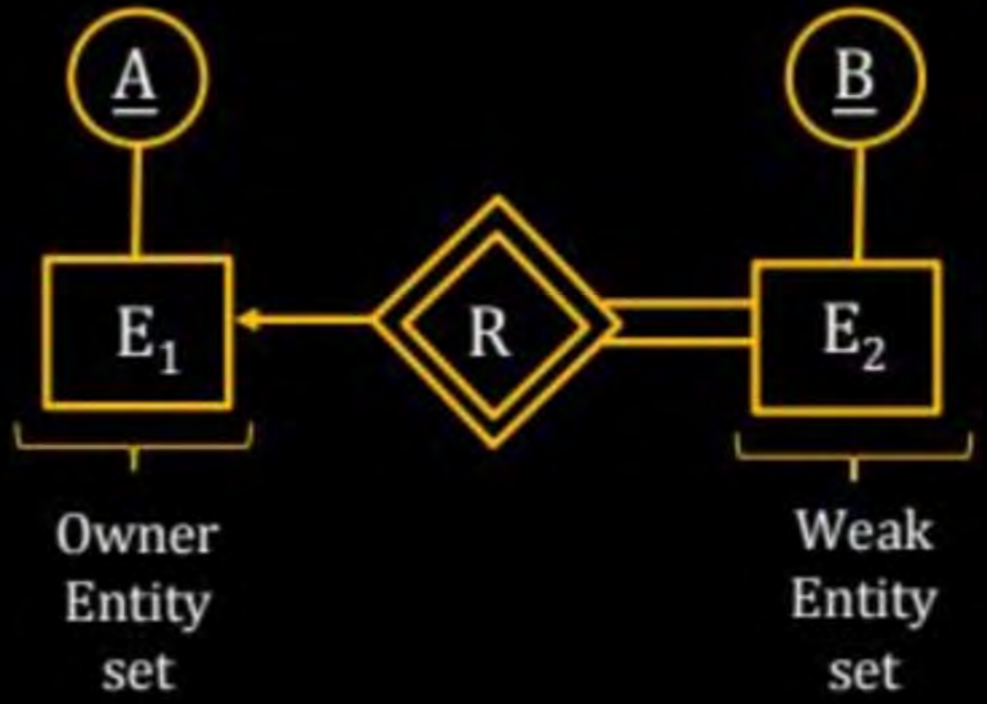
(b) Relationship set between weak entity set and identifier entity set is also "weak relationship set".

(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)

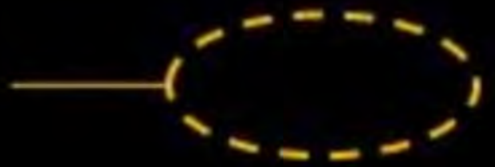
Weak Entity Set and Weak Relationship Set

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.

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

Mapping [Cardinality constraints of relationship set]

(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
1 : M
M : 1
M : N

Merge the entity sets and Relationship into single Relational table so, 1 relational table.

Self-Referential Relationship Set

(Recursive entity set)

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

Recursive
Entity set

Self-referential relationship set

- Binary relationship set
- 1: M, M:1, 1:1, M:N can be any of the relationship

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 from (3NF) is designed form the above ERD. The number of tables in the database is [GATE-2004 : 2 Marks]

A 2

B 3

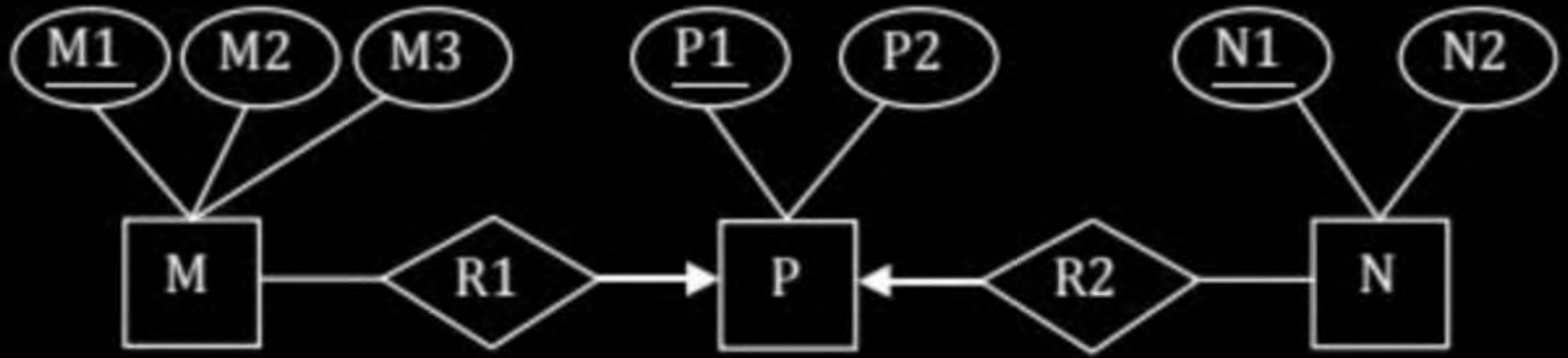
C 5

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}

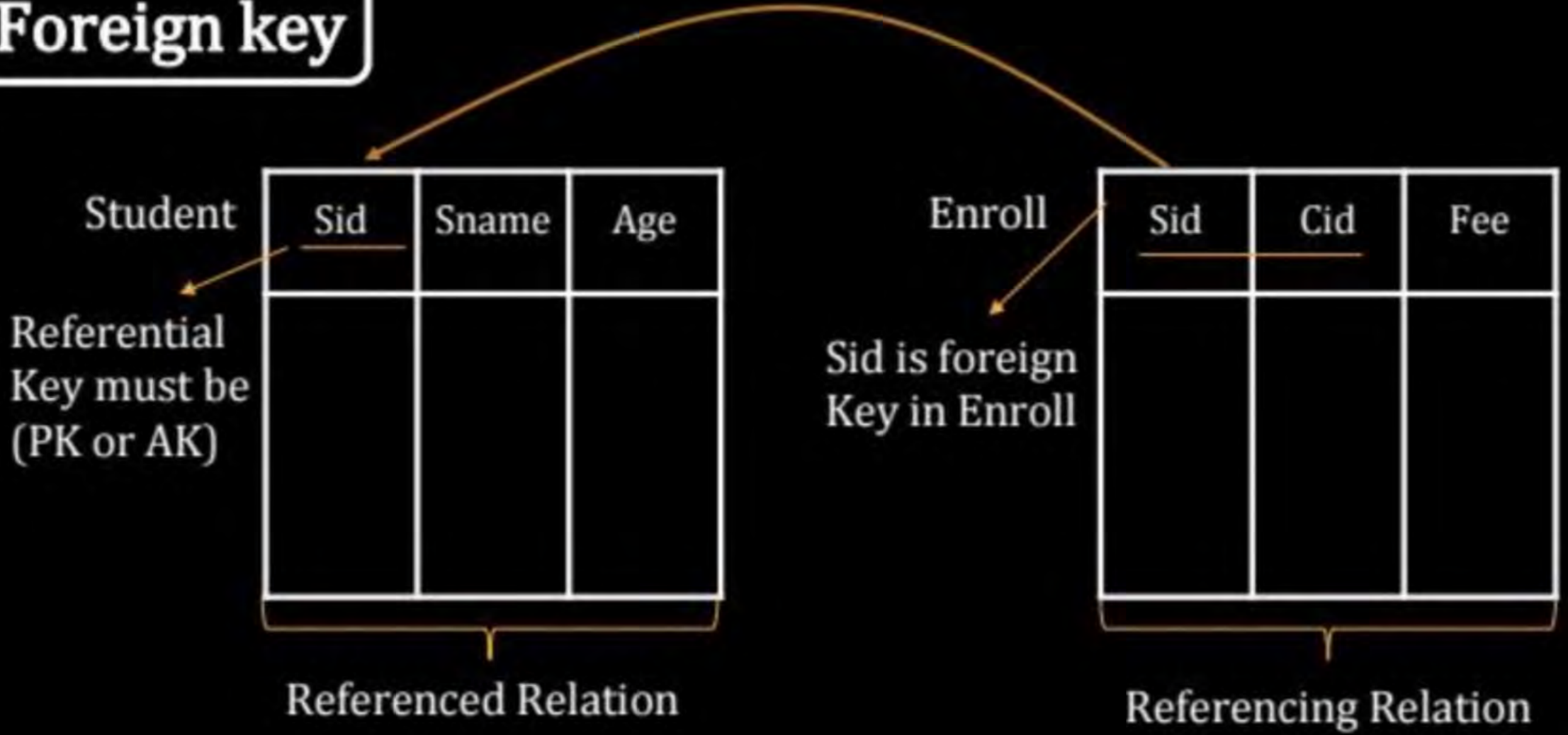
Referential Integrity Constraints

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 alterative 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		
Sid	**Sname**	**Login**
S_1	A	-@
S_2	A	--@
S_3	B	---@
S_4	C_1	----@

Enrolled		
Sid	**Cid**	**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 →

STUDENT		
Roll No	Name	Branch
1	A	CSE
2	B	IT
3	C	CSE

Registration		
CNo	Cname	Roll No
101	DBMS	1
102	OS	1
103	CD	3
104	TOC	–

← F.K

Referenced Relation
(Parent)

Referencing Relation
(CHILD)

Note: The value present in Foreign key must be Present in Primary key of Referenced relation

Foreign key may contain duplicate & NULL values.

Parent table	CHILD table
Referenced table	Referencing Relation
✓ Insert < 4 D ECE>	× Insert < 105 DSA 67
× Delete < 1 A CSE>	✓ Delete < 103 CD 3>

Note: Deletion from the Referenced Relation and Insertion into Referencing Relation may violate Foreign key constraint.

Note: A Relation can Act as Parent & CHILD i.e. Relation may contain a primary key & a Foreign key that Refer to the same Relation.

Referential Integrity Constraint

(1) Referenced Relation

(i) Insertion : No Violation

(ii) Deletion : May cause Violation if Primary key is used by referencing relation

I. ON DELETE NO ACTION.

II. ON DELETE CASCADE.

III. ON DELETE SET NULL.

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

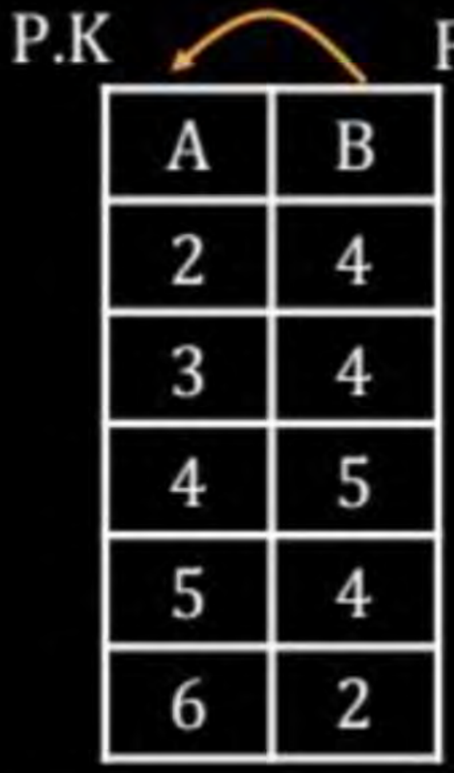
Referencing Relation

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



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.

Q.

The following table has two attributes A and C where A is the primary key and C is the foreign key referencing A with on-delete cascade.

The set of all tuples that must be additionally deleted to preserve referential integrity when the tuple (2, 4) is deleted is:

A	C
2	4
3	4
4	3
5	2
7	2
9	5
6	4

A (,3 4) and (6, 4)

B (5, 2) and (7, 2)

C (5, 2), (7, 2) and (9, 5)

D 1

Q. Let R (a, b, c) and s(d, e, f) be two relation in which d is the foreign key of S that refers to the primary key of R. Consider the following four operations on R and S.

(i) Insert into R

(ii) Insert into S

(iii) Delete from R

(iv) Delete from S

Which of the following is true about the referential integrity constraint above?

A. None of (i), (ii), (iii), or (iv) can cause its violation

B. All of (i), (ii), (iii), and (iv) can cause its violation

C. Both (i) and (iv) can cause its violation

D. Both (ii) and (iii) can cause its violation

Q. In which one of the following Lock Scheme Deadlock cannot occur? [MCQ]

A. Basic 2PL

B. Strict 2PL

C. Conservative 2PL

D. Rigorous 2PL

Q.

Consider the following statement about lock–based protocol

(A) 2 PL (2phase locking) protocol Ensure view serializability

(B) 2PL ensure recoverability &No cascading rollback.

(C) Strict 2 PL ensure recoverability & no cascading rollback.

(D) Strict 2 PL avoids deadlock (not suffering from deadlock).

How many numbers of above statement are correct?

[MCQ]

A 1

B 2

C 3

D 4

Q.

Consider the following Schedule: [MSQ]

$r_1(x)\ r_2(y)\ r_2(x)\ w_1(z)\ r_1(y)\ w_3(y)\ r_3(z)\ w_2(y)\ w_3(x)$

which of the following time stamp ordering Not allows to execute schedule using Thomas Write rule time stamp Ordering Protocol?

A. $(T_1, T_2, T_3) = (20, 30, 10)$

B. $(T_1, T_2, T_3) = (10, 20, 30)$

C. $(T_1, T_2, T_3) = (10, 30, 20)$

D. $(T_1, T_2, T_3) = (30, 20, 10)$

Q.

Consider the following statements:

S_1: All strict recoverable schedule are serial.

S_2: All recoverable schedules are conflict serializable.

S_3: All strict schedules are conflict serializable.

S_4: All conflict serializable schedules are free from cascading rollbacks.

Which of the following is true?

(a) Only S_1 and S_4

(b) Only S_2, S_3 and S_4

(c) Only S_2 and S_4

(d) None of these

Q.

Consider the following transaction:

T_1: $R_1(x)$ $W_1(x)$ $R_1(y)$ $W_1(y)$

T_2: $W_2(y)$ $W_2(x)$

The number of non-serial schedules between T_1 and T_2 which are serializable?

(a) 2

(b) 13

(c) 15

(d) None of these

THANK YOU!