COMPUTER SCIENCE

Database Management System

ER Model

Lecture_4

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TOPICS
TO BE
COVERED
01
ER to RDBMS Conversions

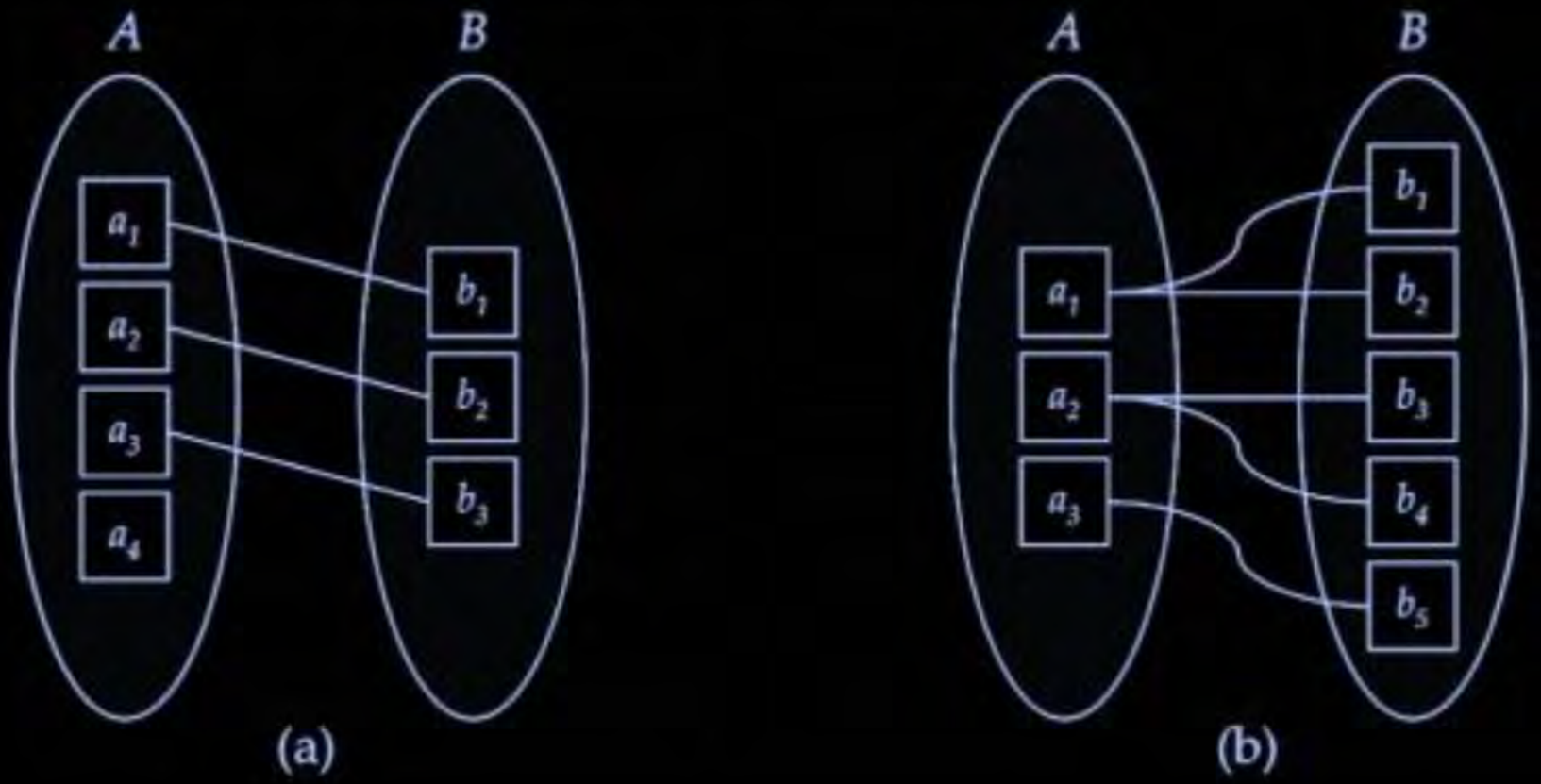
ER MODEL Concept

ER MODEL to RDBMS Conversion

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:
  - One to one
  - One to many
  - Many to one
  - Many to many

Mapping Cardinalities

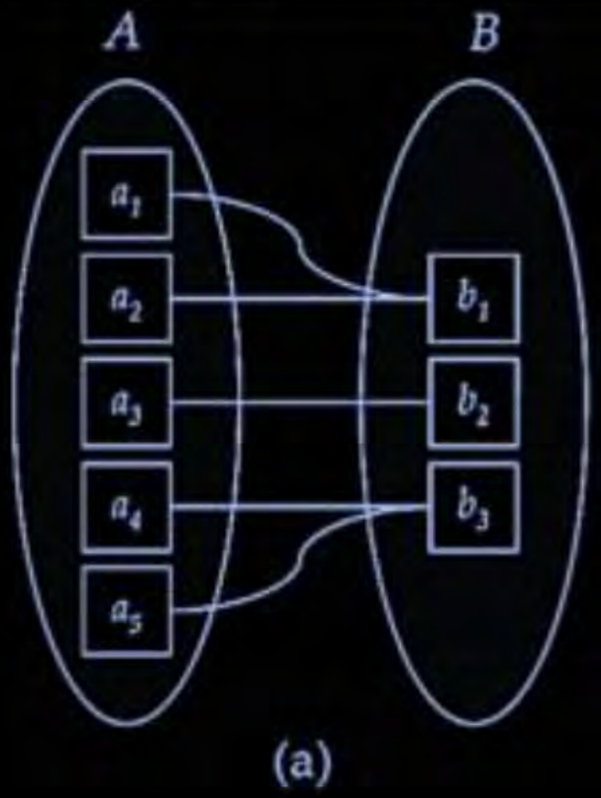


One to one

One to many

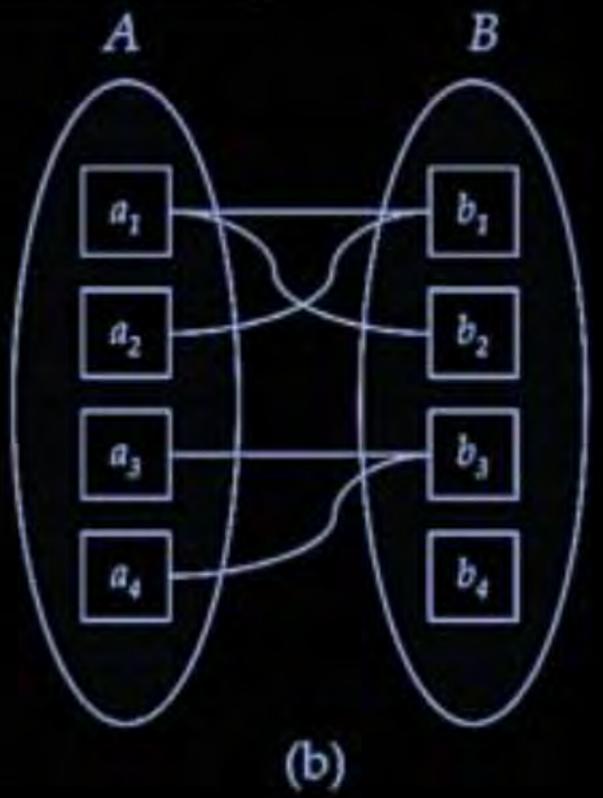
Note: Some elements in A and B may not be mapped to any elements in the other set

Mapping Cardinalities



(a)

Many to one



(b)

Many to many

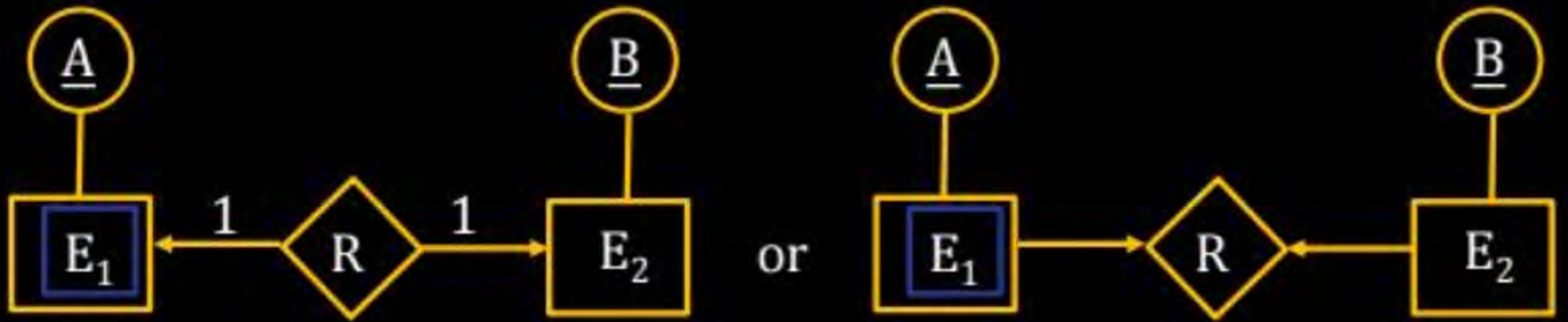
Note: Some elements in A and B may not be mapped to any elements in the other set

Mapping [Cardinality constraints of relationship set]

One mapping : At most one (0 or 1)

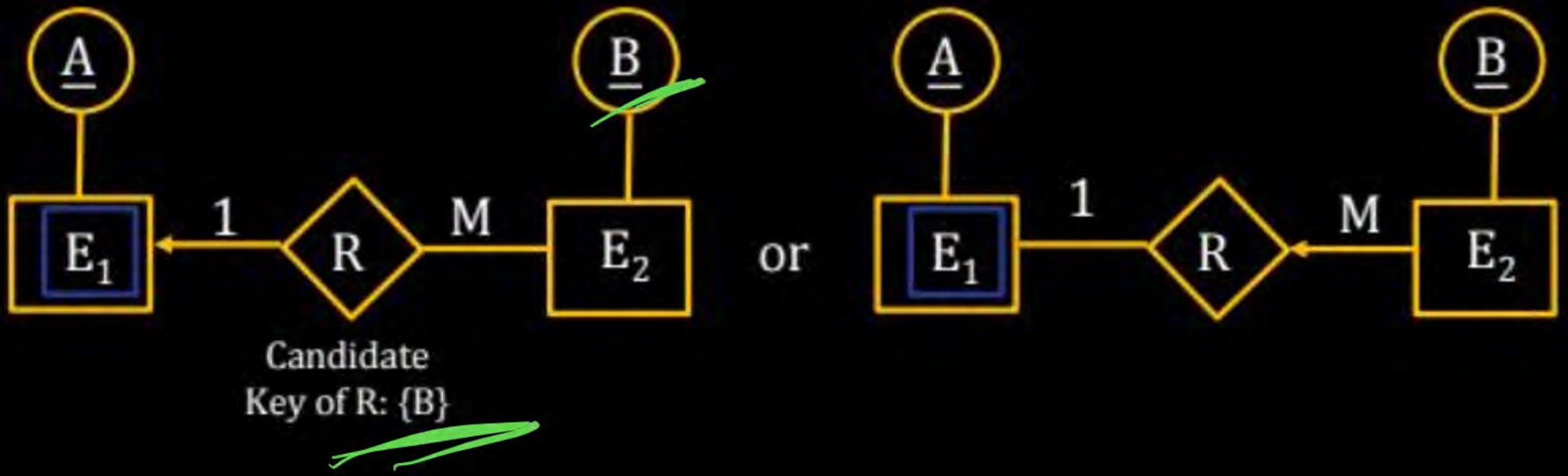
Many mapping : 0 or more (0 ..... *)

Binary Relationship Mapping (One : One)



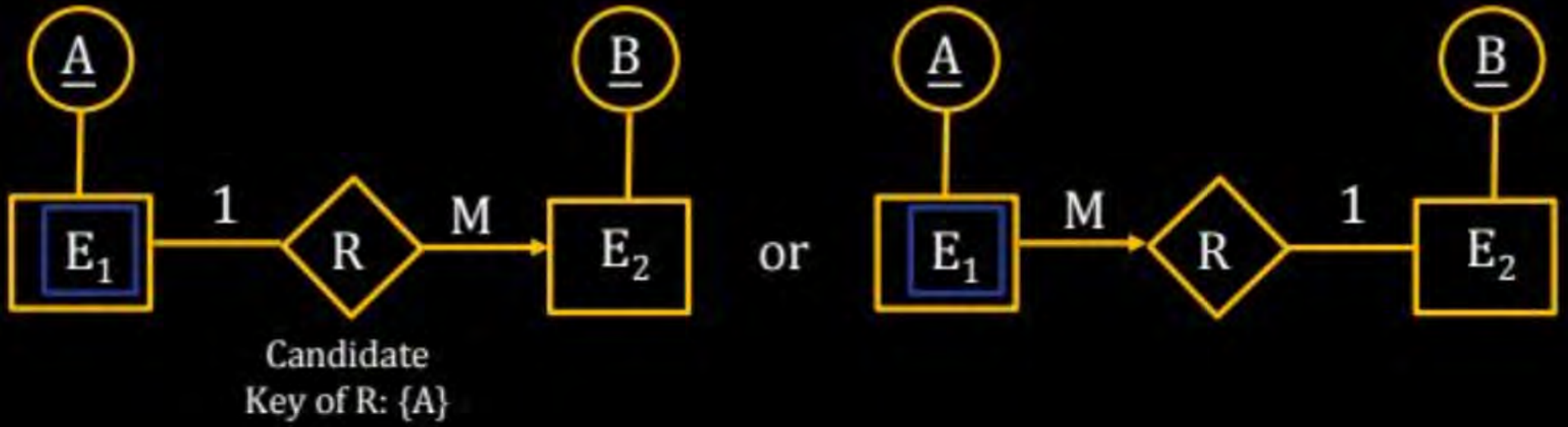
Mapping [Cardinality constraints of relationship set]

Binary Relationship Mapping (One : Many)



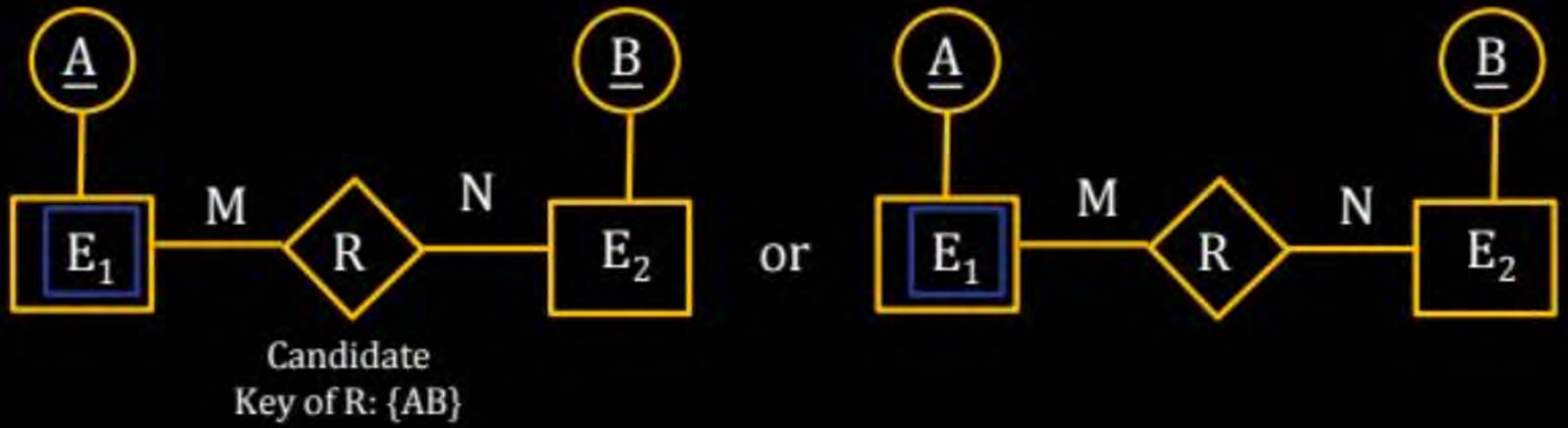
Mapping [Cardinality constraints of relationship set]

Binary Relationship Mapping (Many to One)

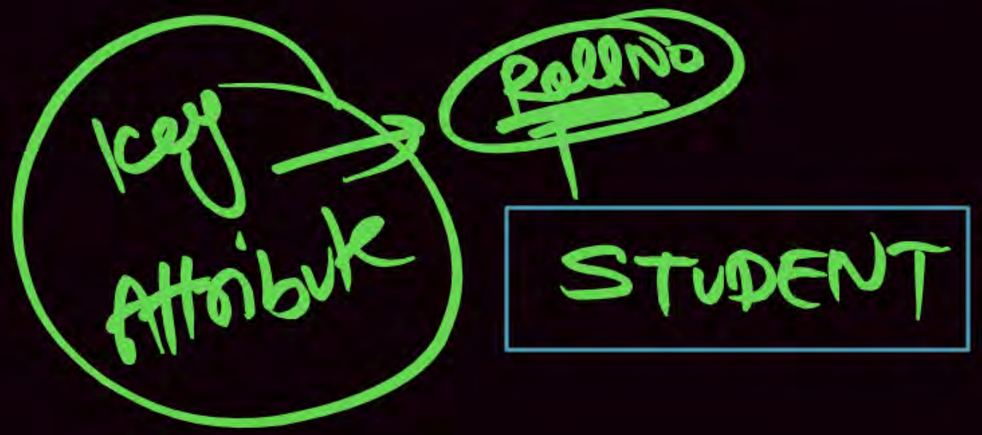


Mapping [Cardinality constraints of relationship set]

Binary Relationship Mapping (Many to Many)



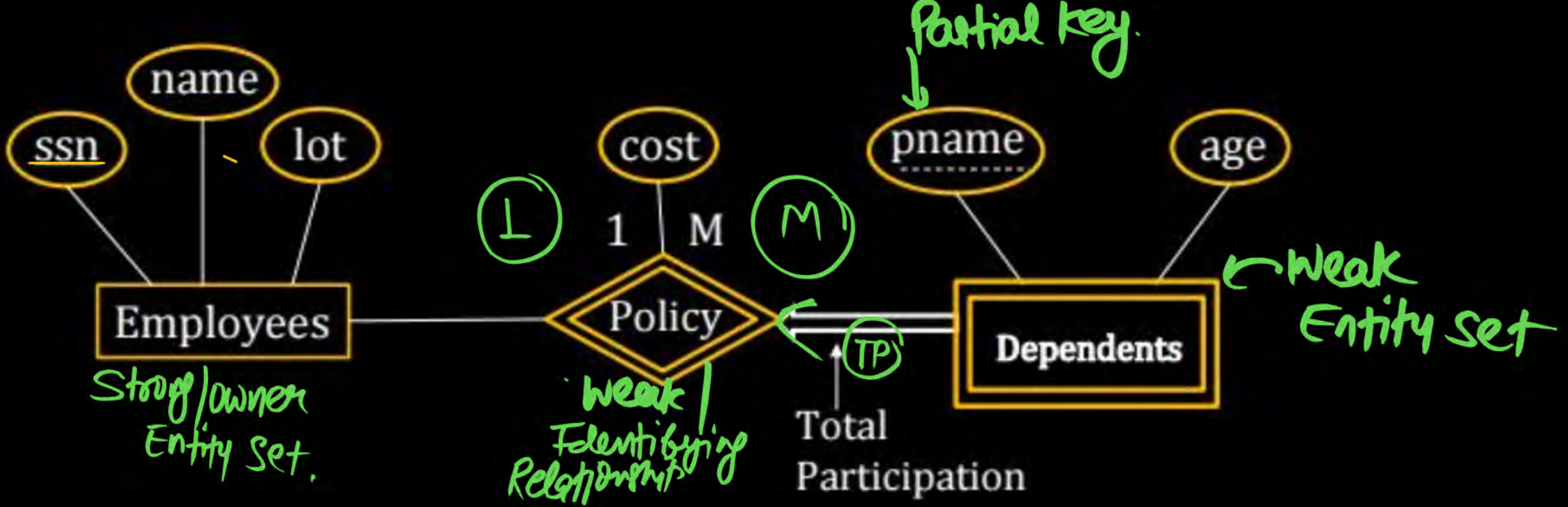
Strong Entity Set



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.

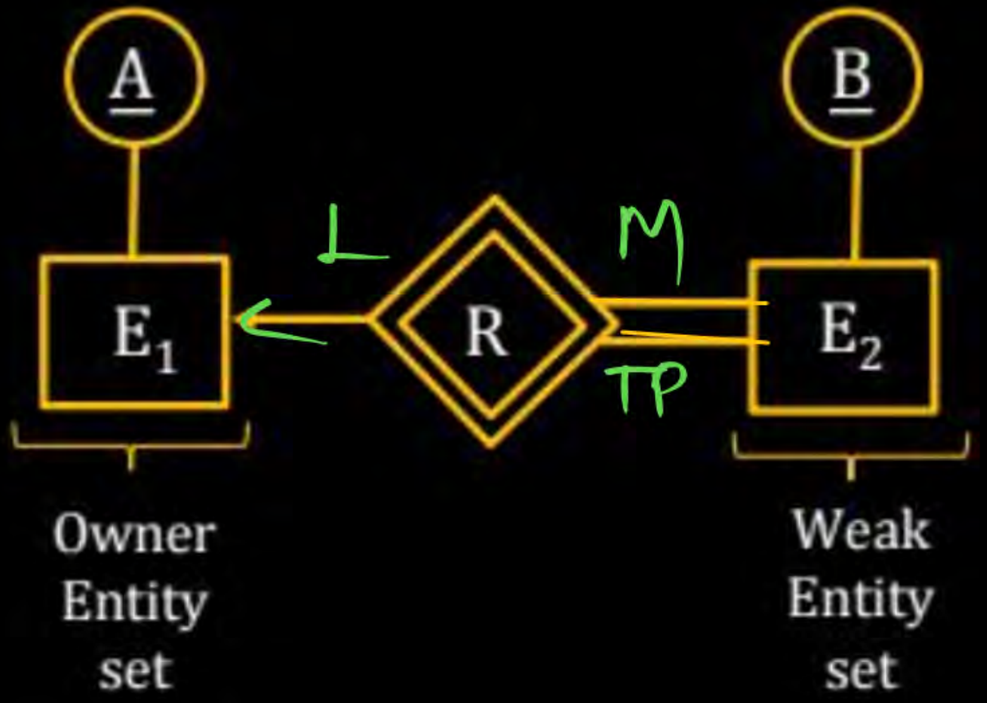
(b) Relationship set between weak entity set and identifier entity set is also "weak relationship set".

(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)

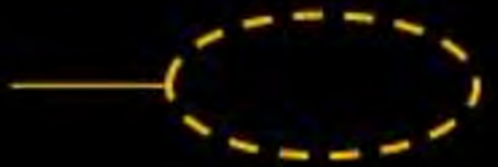
Weak Entity Set and Weak Relationship Set

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

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

ER to Relational Model Conversion

ER MODEL → RDBMS

Entity Set → RDBMS Table

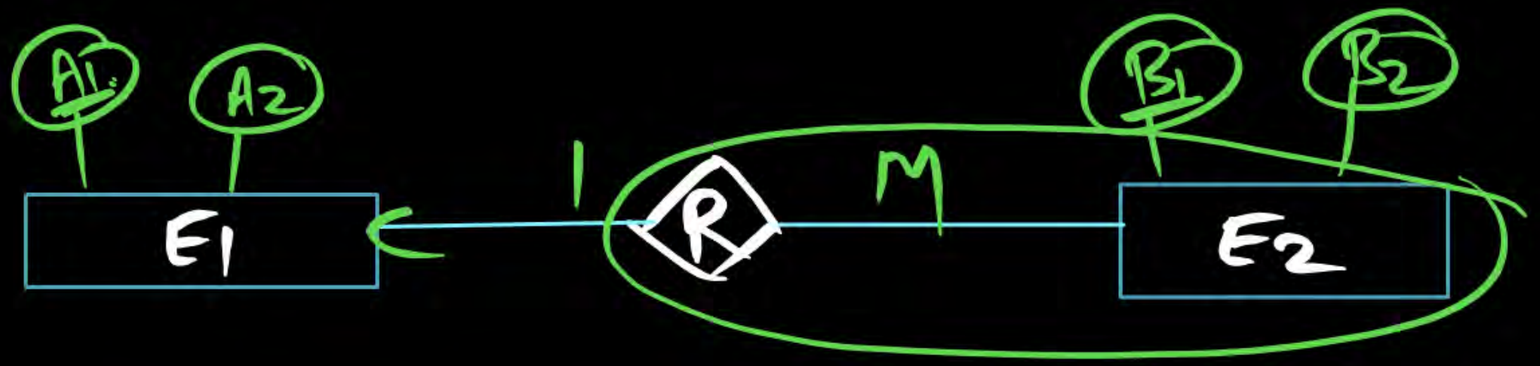
key Attribute → Primary key

Composite Attribute → Set of Simple Component

Multivalued Attribute
- Total → key + All other Attribute
- 2 Table → key + All Multivalued Attribute.

ER to RDBMS Conversion.

1. 1 to Many : 2 Table & 1 Foreign key (Relationship Merge with many side)
2. Many to 1 : 2 Table & 1 F.K
3. Many to Many : 3 Table & 2 FK (1 Table for Entity set 1, 1 Table for Entity set 2, 1 Table for Relationship set)
4. 1 to 1 : 2 Table & 1 FK (either Merge Left side (OR) Right side)



2 Table

E1(A1 A2) RE2(B1 B2 A1)

F.K

2 Table

E1R(A1 A2 B1) E2(B1 B2)

& 1 F.k

F.k

3 Table

E1(A1 A2) R(A1 B1) E2(B1 B2)

F.K

F.k

2 Table

E1R(A1 A2 B1) & E2(B1 B2)

E1(A1 A2) RE2(B1 B2 A1)

ALL Cases.

(I) Partial Participation

(II) Total Participation (with all Combinations)

(I) Partial Participation.

2 Table

2 Table

3 Table

2 Table

Total Participation.

① 1 to Many

(i)

2 Table

(ii)

2 Table

(iii)

1 Table

(iv)

1 Table.

(2) Many to 1

(i)

2 Table

(ii)

2 Table

(iii)

1 Table

(iv)

1 Table.

(3) Many to many.

(i)

3 Table

(ii)

2 Table

(iii)

2 Table

(iv)

1 Table

(v) 1 to 1

(i) 

2 Table.

(ii) 

1 Table

(iii) 

1 Table

(iv) 

1 Table

V. Imp Note

① If Total Participation (=) at both side (in 1:1, 1:M, M:1, M:N) then only 1 Table Required.

② If Total Participation (=) at one side (in 1 to M & M to 1 i.e. 1:1) then 1 Table Required

③ If Total Participation At Any one side (in M:N) then 2 Table are Required.

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)

One to Many.

Full participation on "one" side of many to one relationship

Total

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]

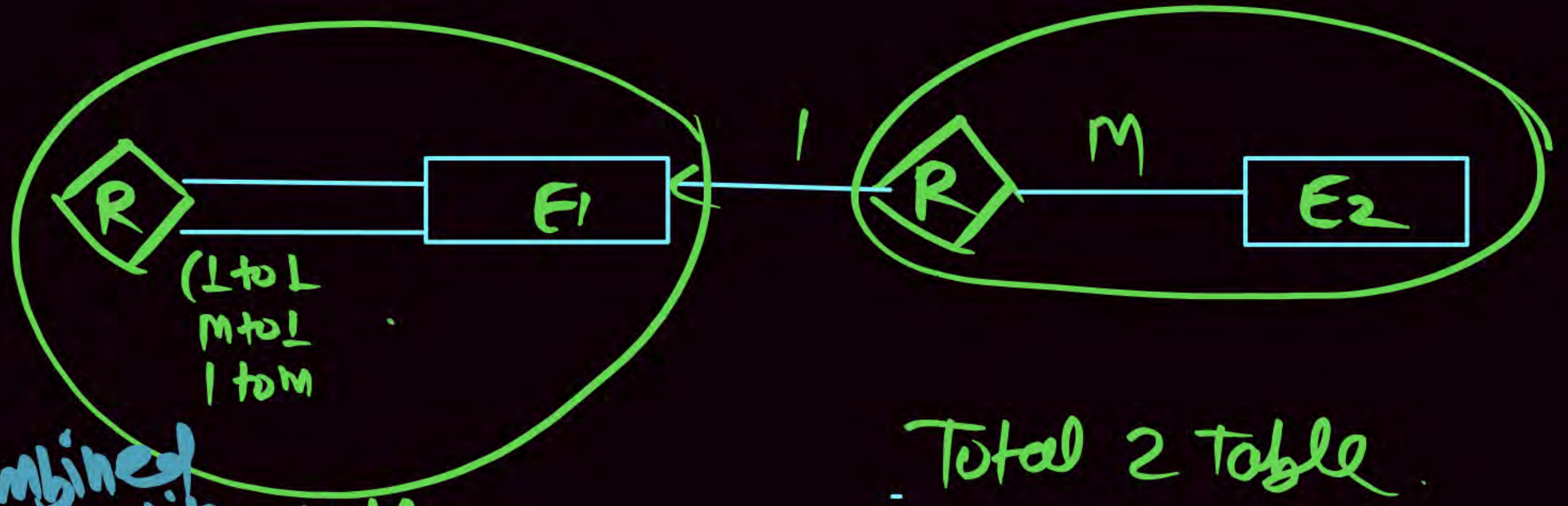
(For binary relationship)

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 Ref. Relationship set :

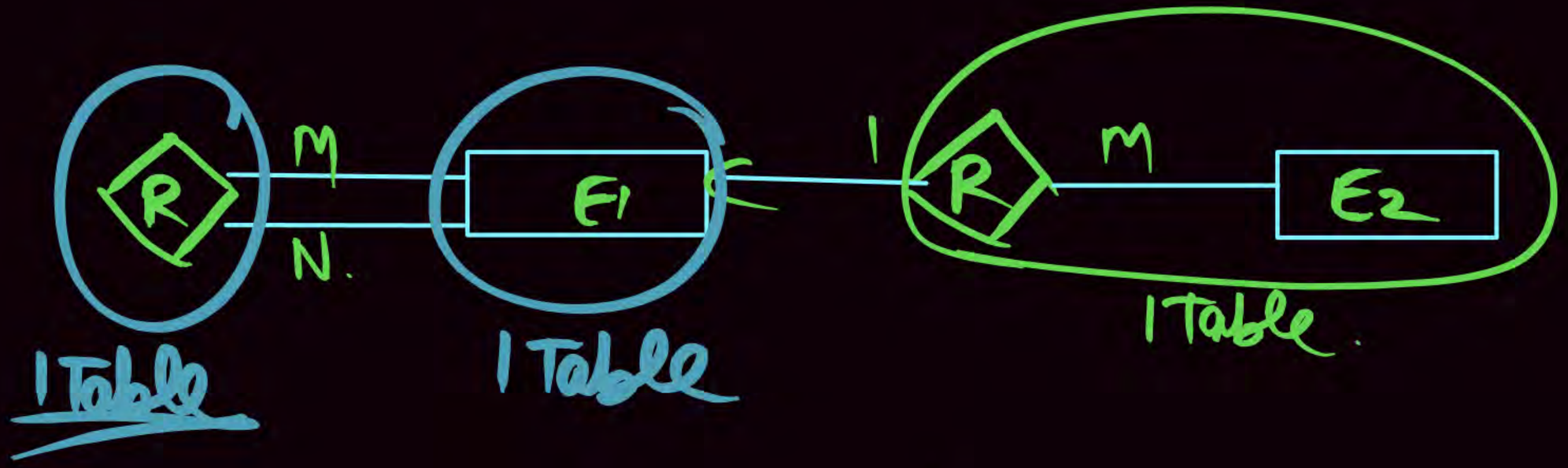


Combined with Entity set

1 Table

Total 2 Table

Self. Ref. Relationship set :



Self-Referential Relationship Set

(Recursive entity set)

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

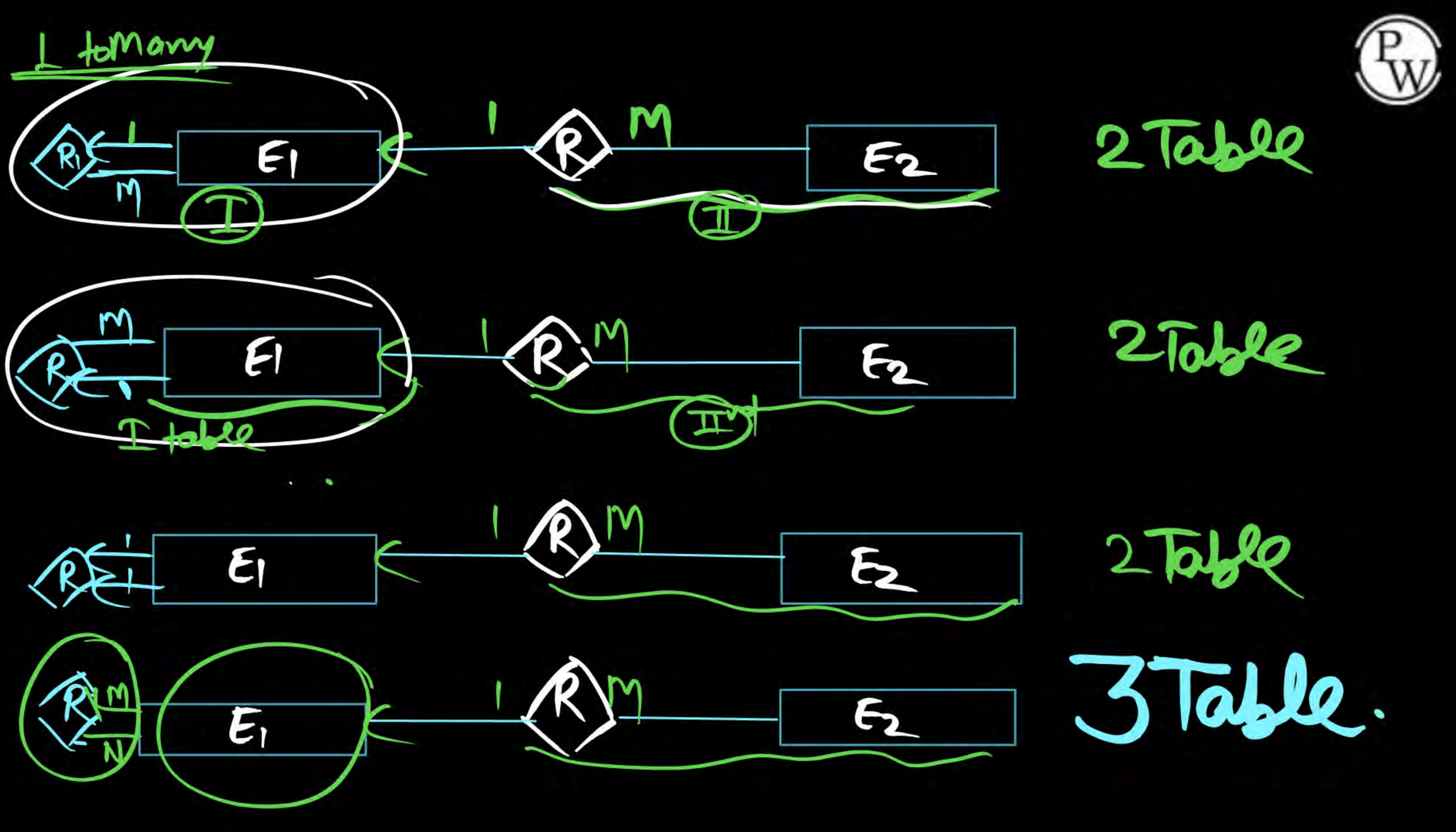
Recursive
Entity set

Self-referential relationship set

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

1:M
M:1
1:1
Combined with entity set

M:N. [More Table Required.]


1 to many
R1
1
M
E1
I
1
R
M
E2
II
2 Table
M
R
E1
I table
1
R
M
E2
II
2 Table
1
R
E1
1
R
M
E2
2 Table
R
M
N
E1
1
R
M
E2
3 Table.

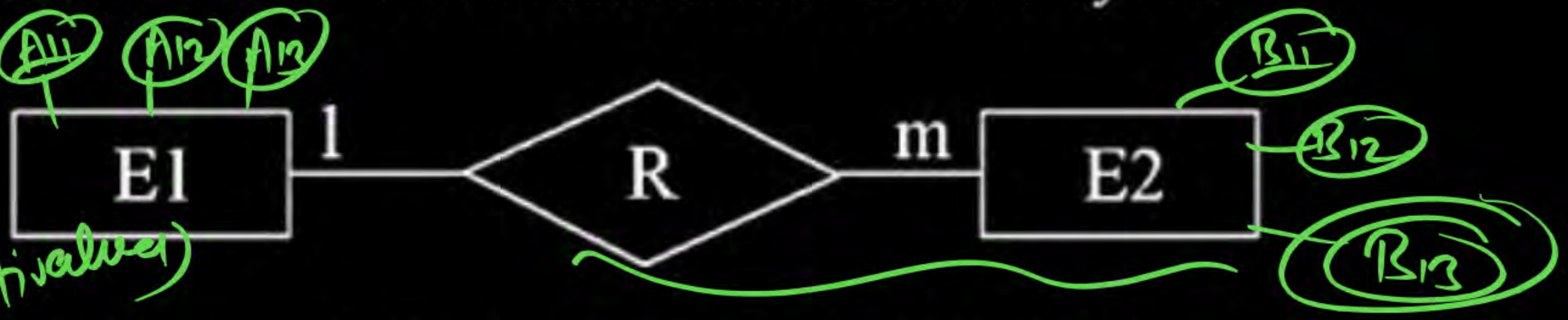
E_1, R, E_2

R_1, R_2

} 5 Table.

Q.

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



1 to M
2 Table
+1 Table (Multivalued)

E1
RE2
E2

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

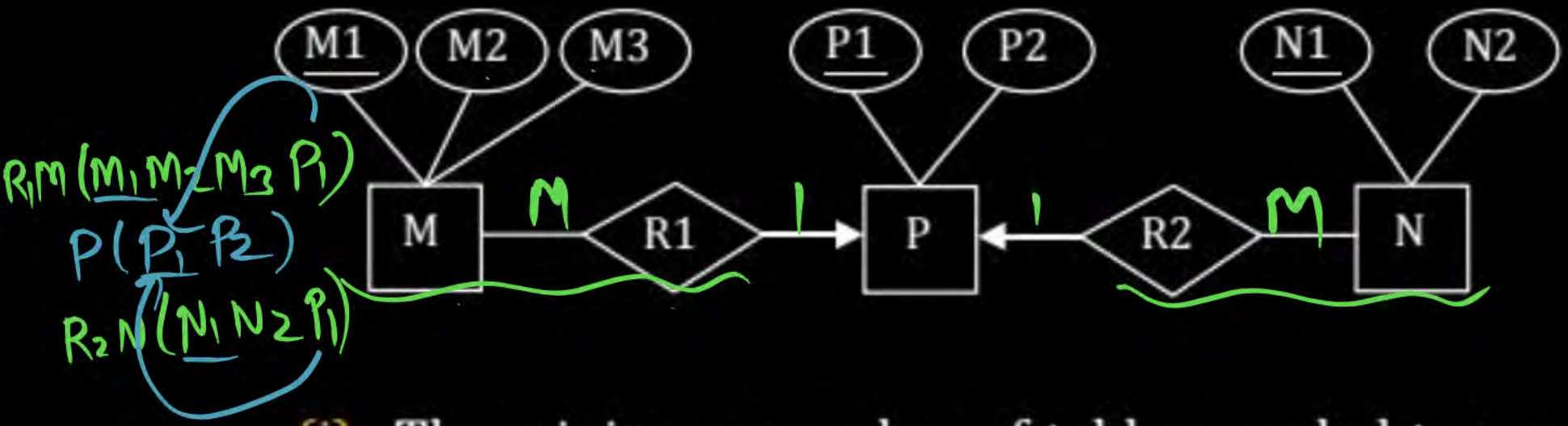
C 5

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}

E-R Model:

Entity Relationship Diagrams used to represent Diagrammatic design [High Level Design] of Databases.

DB Design Steps:

1. Requirement: What type of data stored and what operation required etc.
2. Conceptual and Logical: [ER Diagram]
3. ER Diagram to RDBMS table design and apply normalization.
4. Physical DB Design (Indexing Design)
5. User interface Design && Security Design

High Level Design

Low Level Design

Main Components in ERD:

1. Attributes
2. Entity Sets
3. Relationship Sets

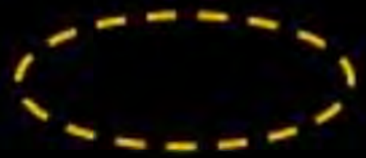
Attribute

Attributes:

Key Attributes:

Multi valued Attribute:

Derived Attribute:

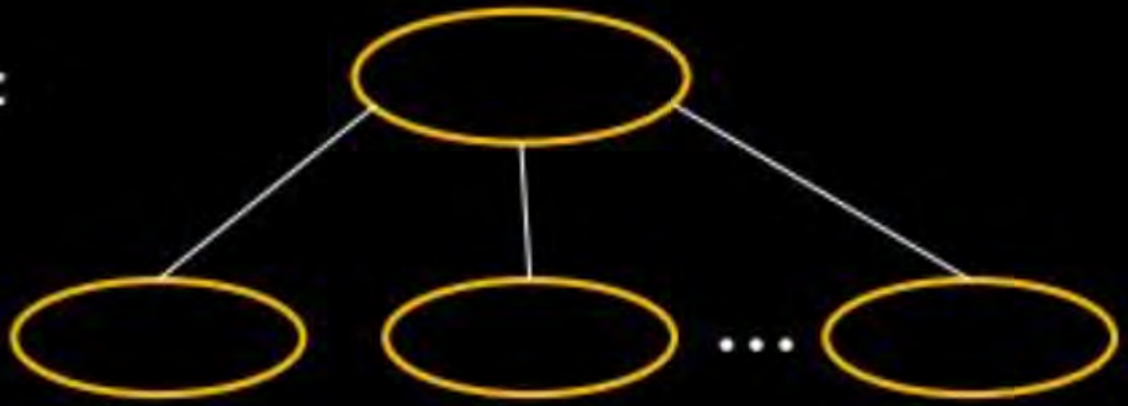


Value derived from
Other stored value

Example:

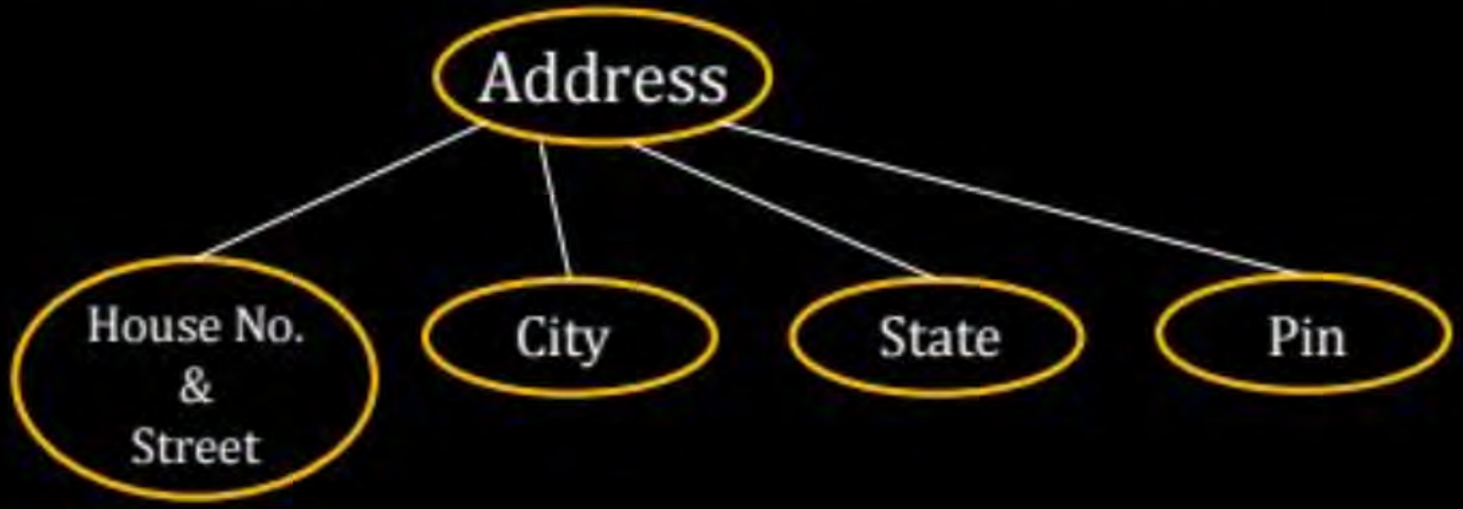
Attribute

Composite Attribute:



Attribute Which can represent as two or more attributes

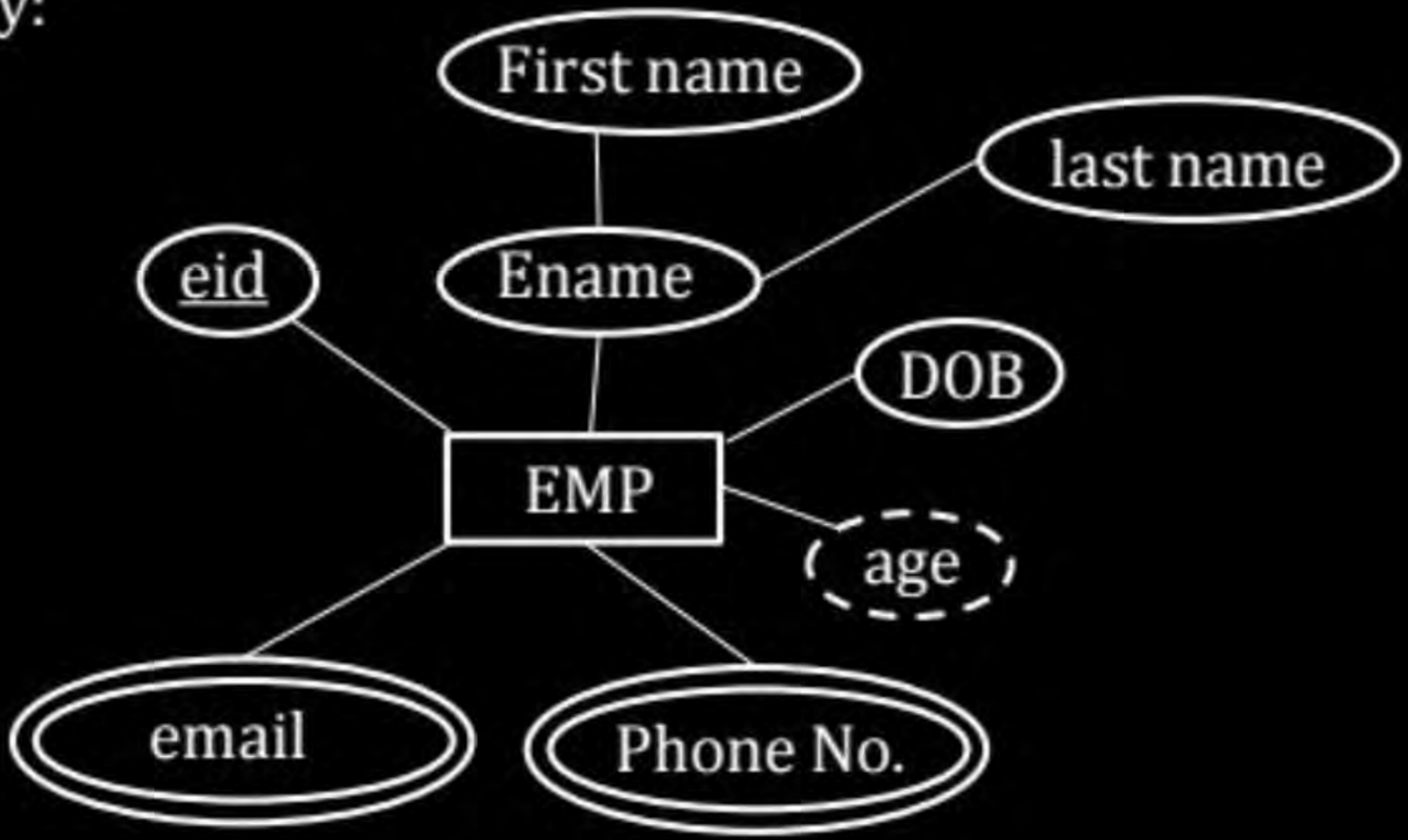
Example:



Entity Set:

Set of similar entities (recorded/objects).

Represented by:



Relationship Set:

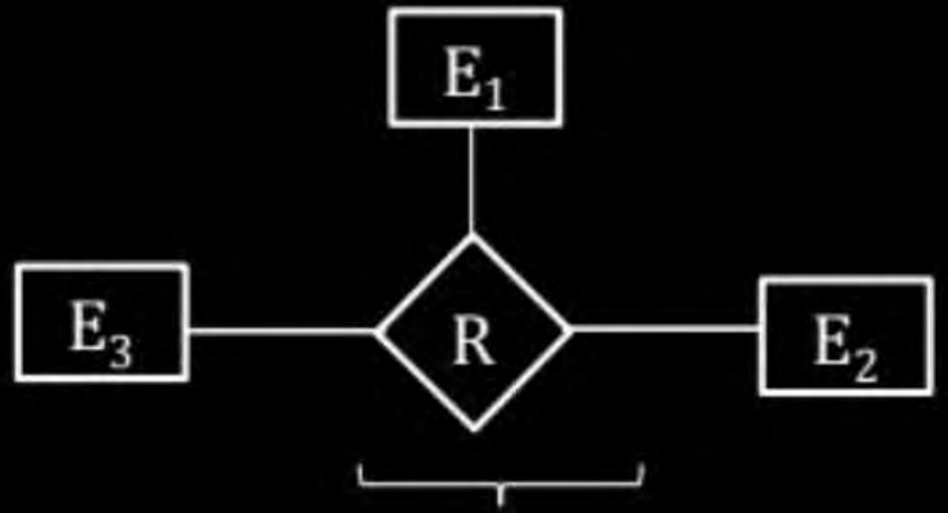
Used to relate two or more entity set.

Represented by:

1.

Binary Relationship

2.



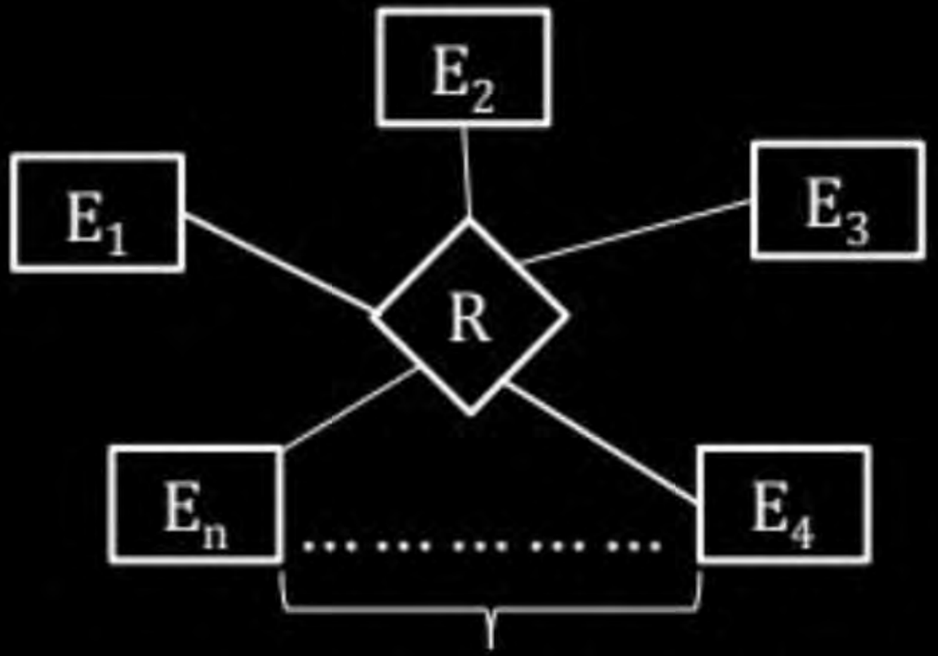
Ternary Relationship

Relationship Set:

Used to relate two or more entity set.

Represented by:

3.



N-ary Relationship

Participation:

If every entity of entity set (E1) must participate with relationship set than Total Participation.

Total

[must be 100% participation]

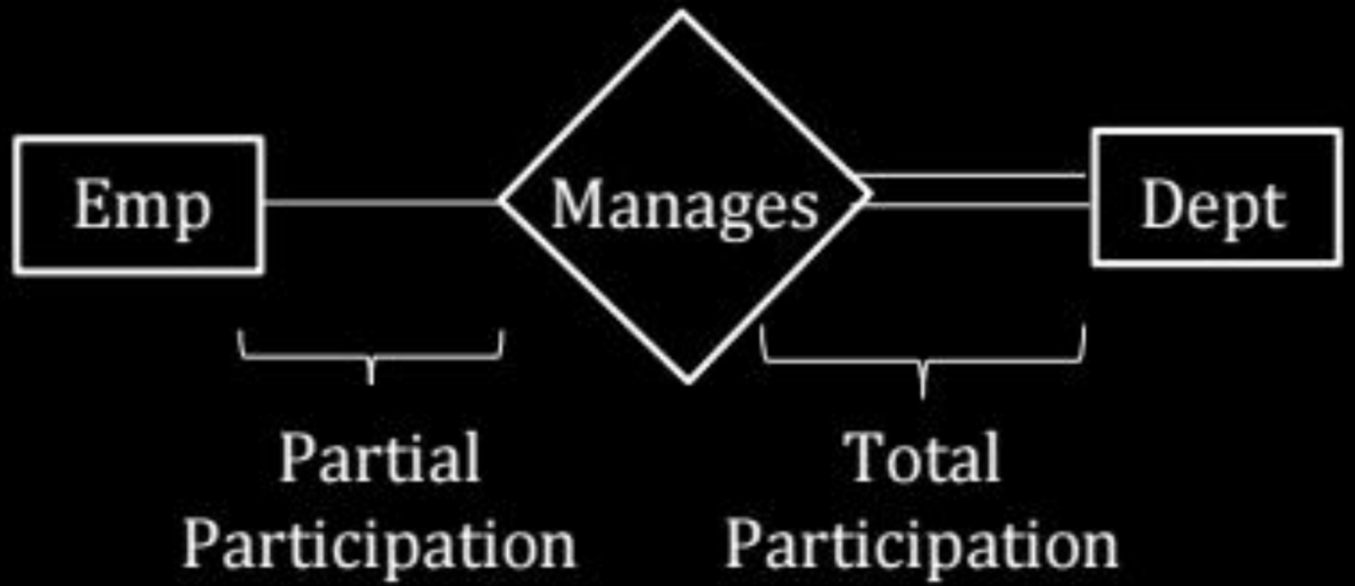
Otherwise:

Partial

Partial Participation:

May or may not 100% participation

Example: "Emp" & "Dept" Entity Set.
"Manages" Relationship Set such that each dept there must be a manager.



Mapping:

Mapping [cardinality of Relationship set]:

One: [At most one] [0.....1]
Many: [0 or more] [0.....M]

Possible Mapping of binary relationship sets are:

1) One : One
2) One : Many
3) Many : One
4) Many : Many

Candidate key's of Relationship set is Based on mapping

Q.1 In ER How the find key for Relationship set

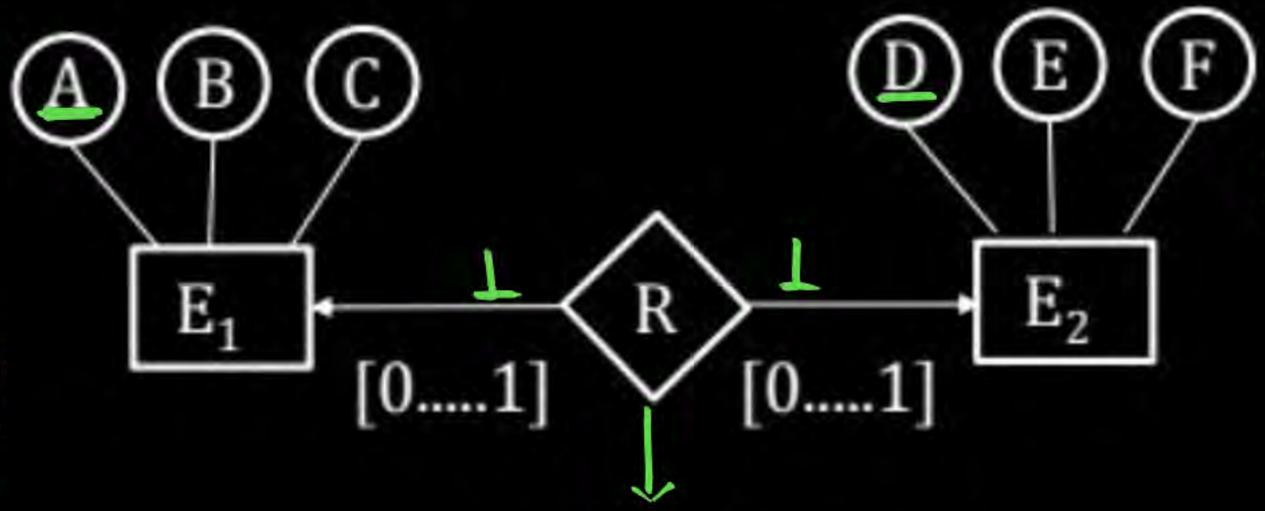
Q.2 Why we Merge the Table at Many Side!

Q.3 ER to RDBMS Conversion How to check Normal - Form.

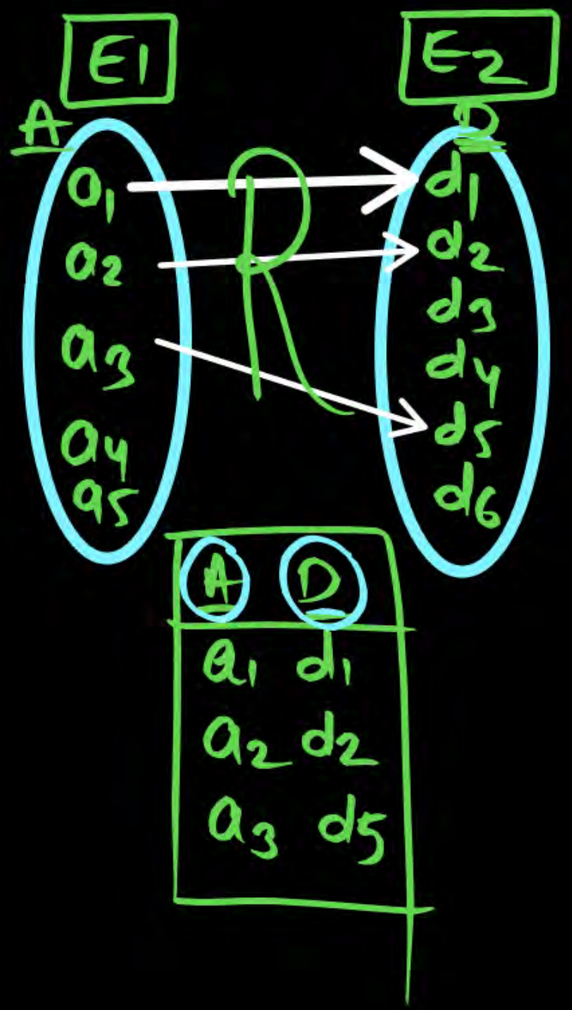
Q.4 Both Side Total Participation meaning ?

One to One:

A → BC



D → EF



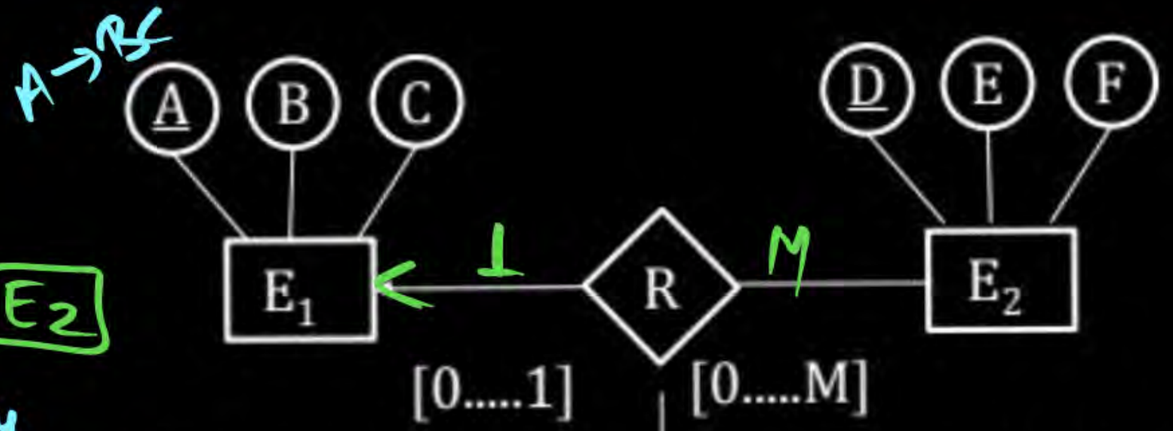
One to One

R (A D) ≡ {A, D}

a_1	d_1	1 : 1 mapping
a_2	d_2	candidate key of
a_3	d_5	Relationship set

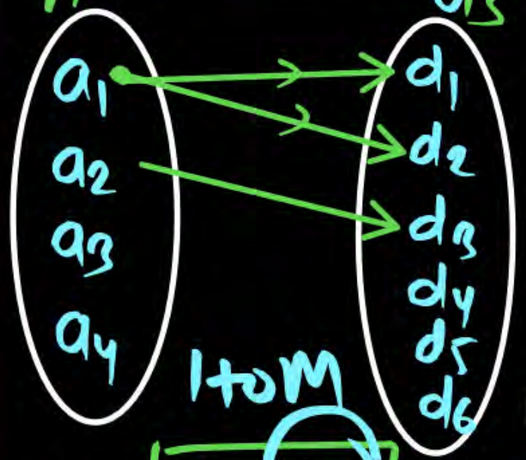
P. key: Unique + Not NULL

One: Many:



E_1 1 R M E_2

1 to Many.



Each object of E_2 allowed to pair by at most one entity of E_1

Each entity of E_1 can pair with many E_2 entity.

1 to M

A	D
a_1	d_1
a_1	d_2
a_2	d_3

[c.key : D]

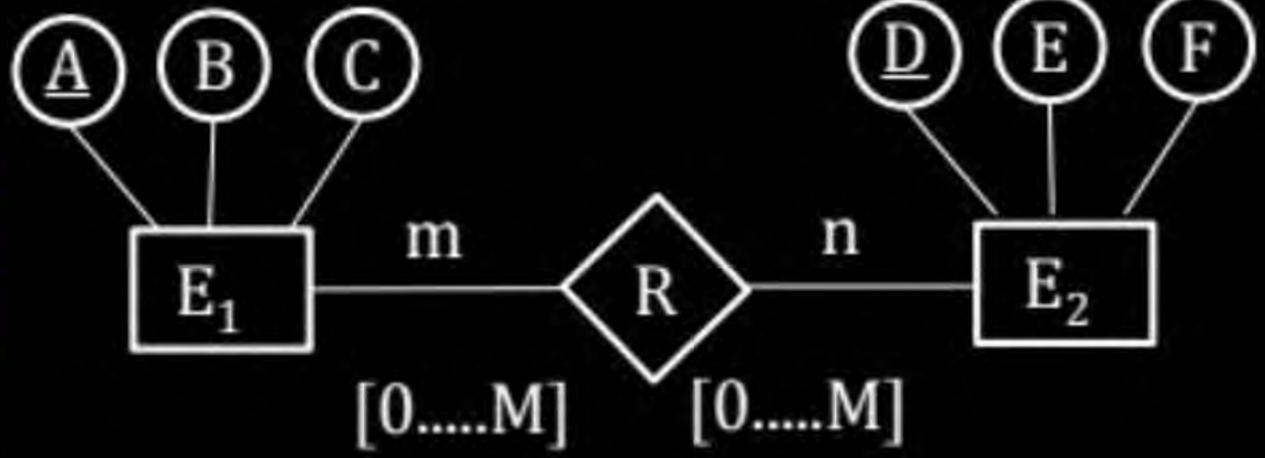
Unique.

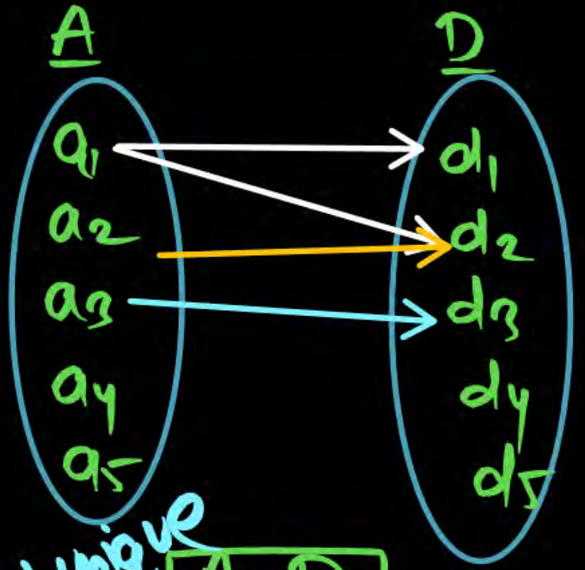
Candidate key of R (A D) ≡ {D}

A	D
a_1	d_1
a_1	d_2
a_2	d_3

: for 1: M Relationship

Many to Many:





A: Not Unique
D: Not Unique
AD: Unique

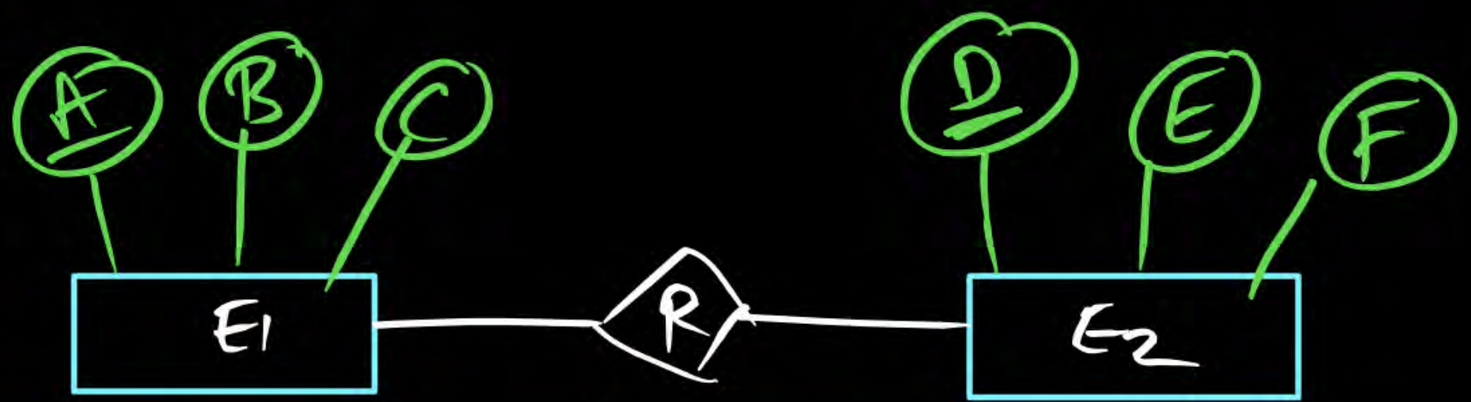
A	D
a_1	d_1
a_1	d_2
a_2	d_2
a_3	d_3

Cand. key = AD

R (A D) ≡ {AD}

a_1	d_1	M:N ⇒
a_1	d_2	for many to many mapping
a_2	d_2	Candidate Key for
a_3	d_3	Relationship Set is
		{AD}

V. Imp.



E_1 & E_2 Relⁿ		Key of R
①	1 : 1 then	A (or) D
②	1 : m then	D
③	m : 1 then	A
④	m : N then	AD

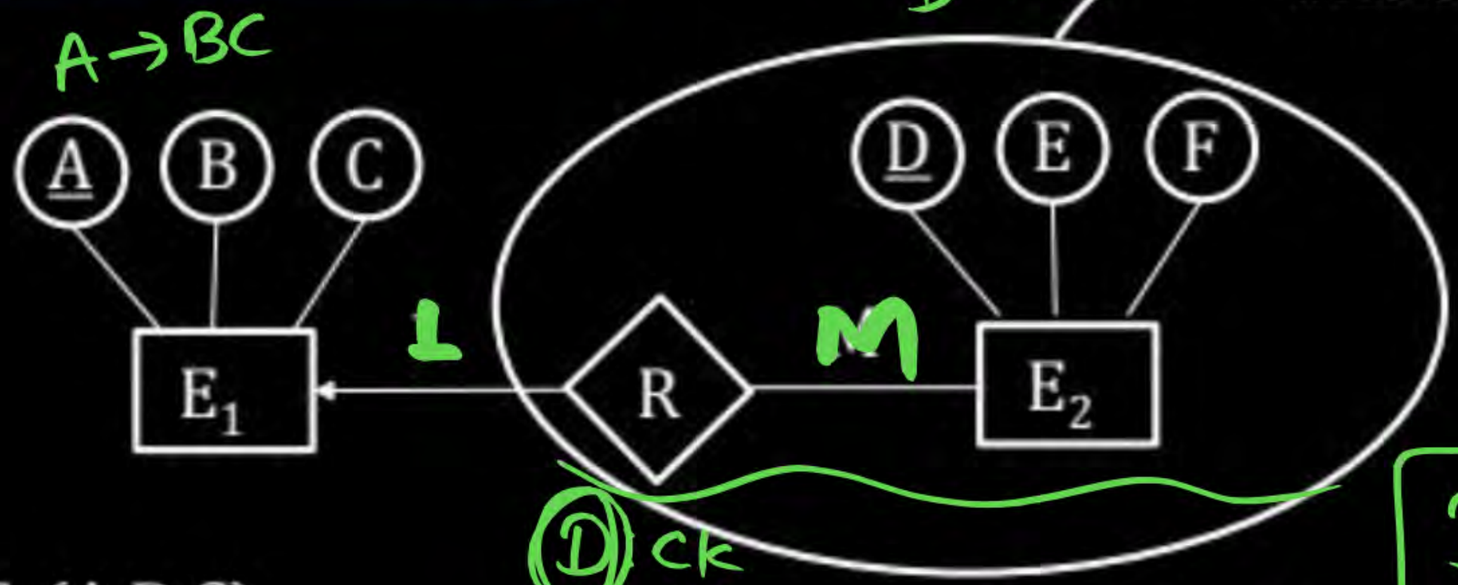
Q.1 How we Merge the table ?

Q.2 WHY we Merge the Table at Many Side in 1 to Many ?

Q.3 How to check Normal Form While Conversion from ER to RDBMS ?

RDBMS Design of Given ERD:

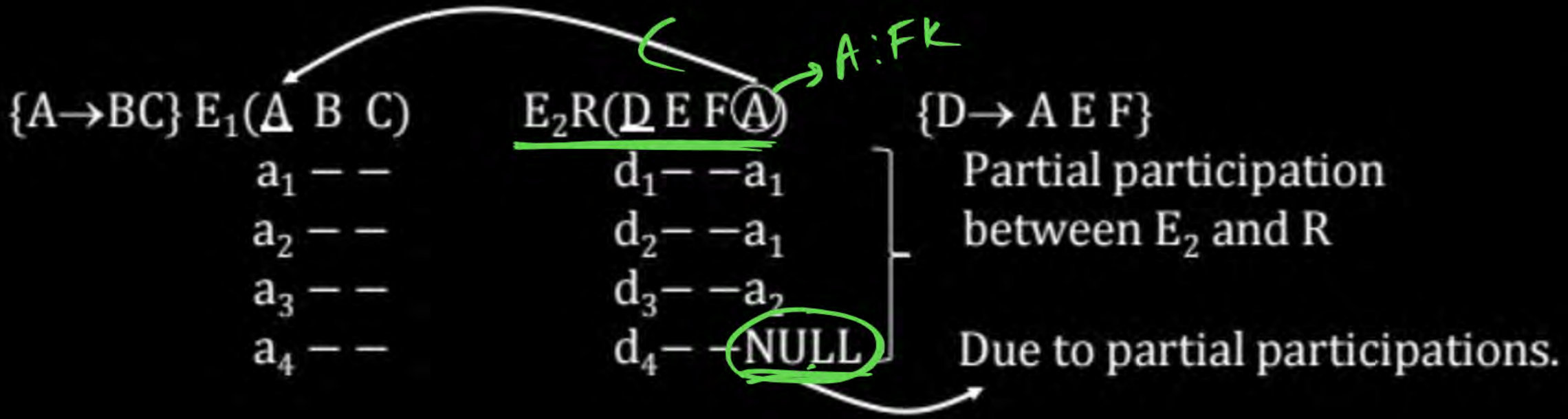
(1) 1 : M Relationship:



D ck

$E_1(\underline{A}\ B\ C)$ $R(A\ \underline{D})$ $E_2(\underline{D}\ E\ F)$

E_1	R	E_2
a_1 — —	$a_1\ d_1$	d_1 — —
a_2 — —	$a_1\ d_2$	d_2 — —
a_3 — —	$a_2\ d_3$	d_3 — —
a_4 — —		d_4 — —
$A \rightarrow BC$	$D \rightarrow A$	$D \rightarrow EF$
{A}	{D}	{D}



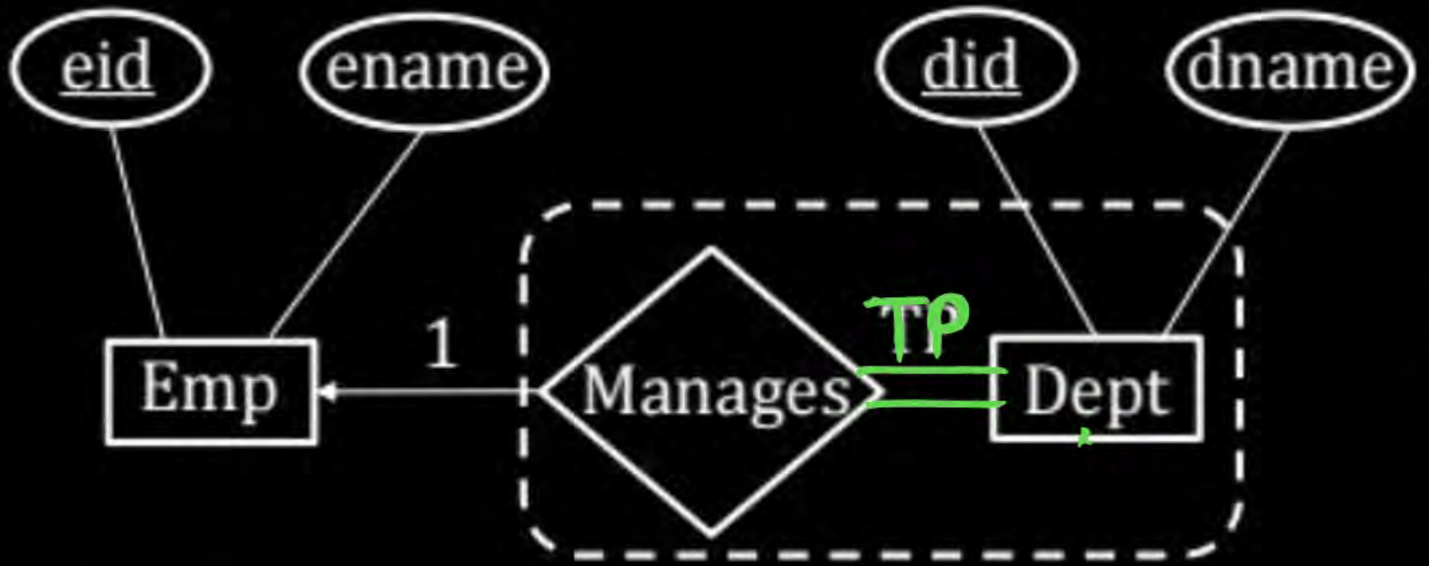
∴ minimum 2 relational Table Required and 1 Foreign Key required for given ERD

CHECK Normal Form

E1(ABC); A→BC; A is Super key.

E2R(DEFA); D→EFA; D is Super key

Given ERD
Example:



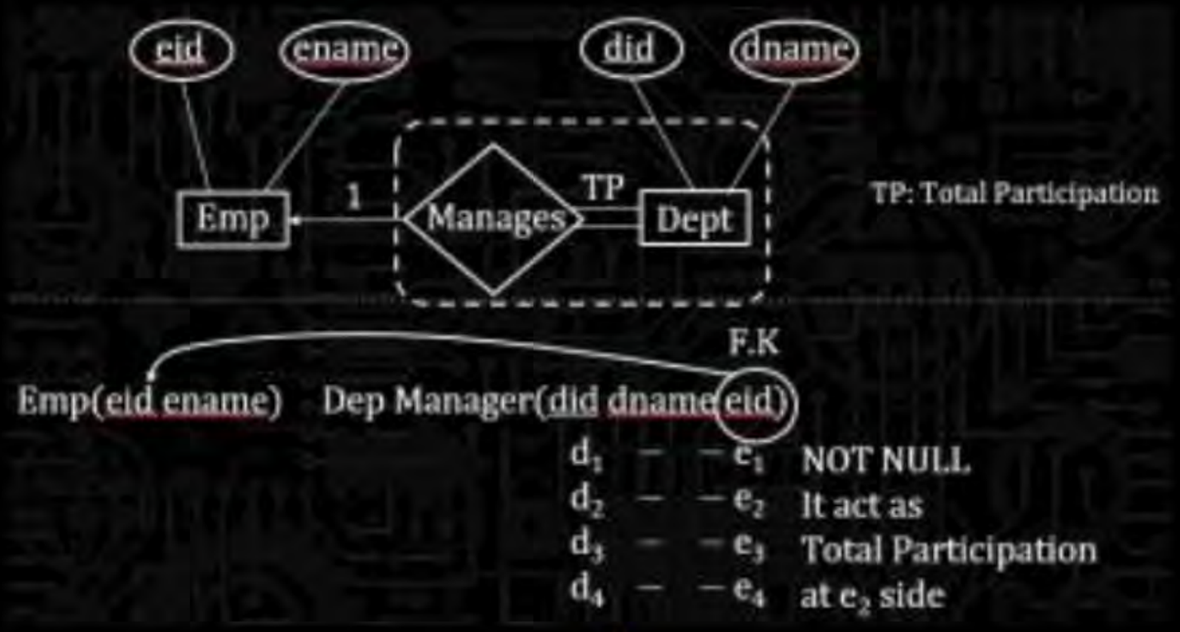
TP: Total Participation

F.K

Emp(eid ename) Dep Manager(did dname eid)

d_1	–	– e_1	NOT NULL
d_2	–	– e_2	It act as
d_3	–	– e_3	Total Participation
d_4	–	– e_4	at e_2 side

Given ERD

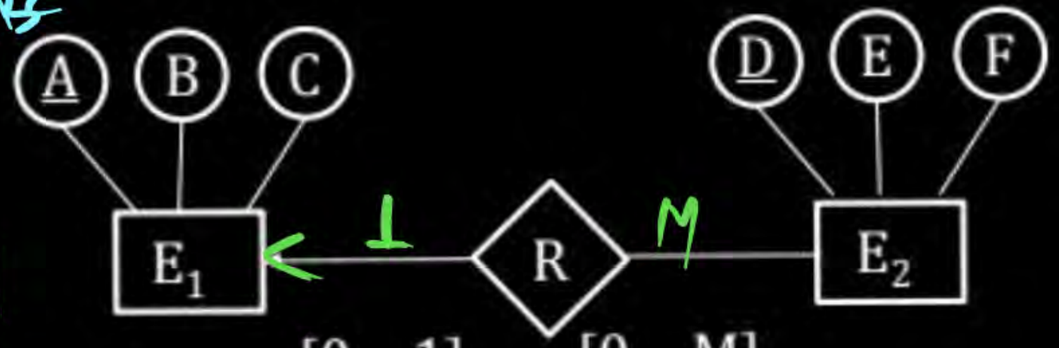


Emp_Dept_Manages
(did dname eid ename)
did → dname
did → eid
(_____ e_5 A)
Not allowed because e_5 not in relationship

CREATE TABLE Dept_manages
(did varchar(10) primary key,
dname varchar(30),
eid varchar(10) NOT NULL,
FOREIGN KEY(eid)
REFERENCES Emp);

One: Many:

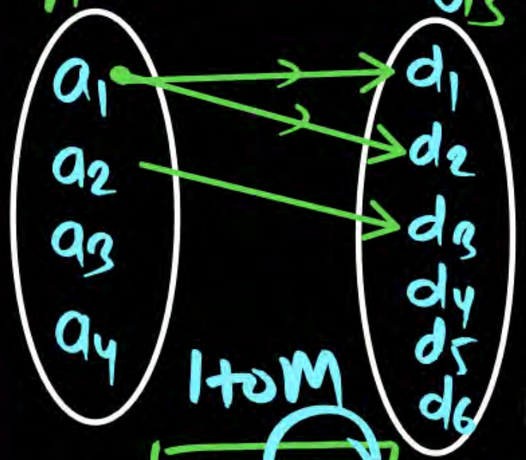
A → BC



D → EF.

E1 1 R M E2

1 to Many:



[0.....1] [0.....M]

Each object of E_2 allowed to pair by at most one entity of E_1

Each entity of E_1 can pair with many E_2 entity.

1 to M

A	D
a_1	d_1
a_1	d_2
a_2	d_3

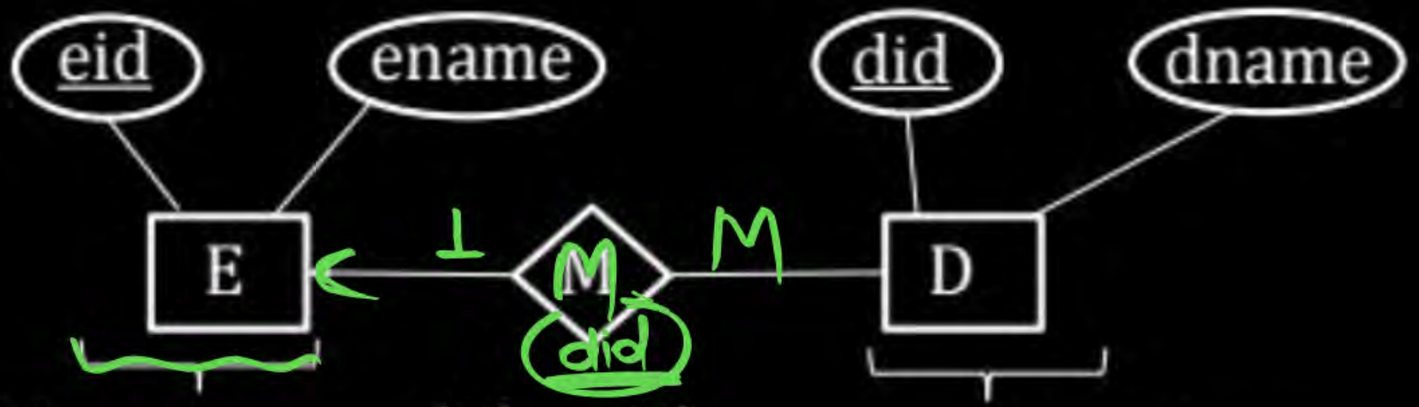
[c.key : D]

Unique.

Candidate key of R (A D) ≡ {D}

: for 1: M Relationship

If 1 : M relationship set merges into left side Entity set:



eid → ename did → eid did → dname

E_M(eid ename did)

D(did dname)

e_1	A	d_1
e_1	A	d_2
e_1	B	d_2
e_1	C	d_3
e_1	D	Null

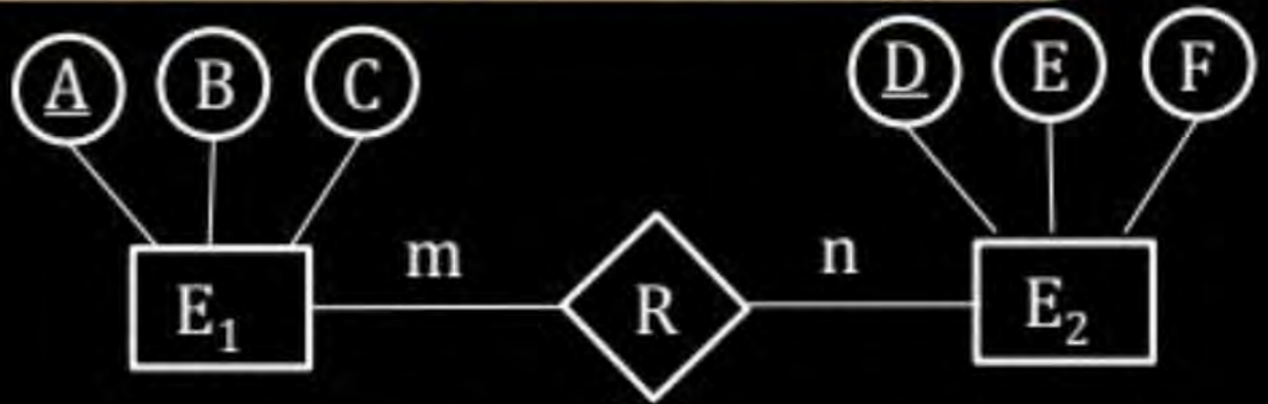
Not valid as did is key of E_M
(Partial Participation)
[lost at E side]

Disadvantage:

1) Data Redundancy Occurs
   eid → ename
   Not Super Key(S.K)

2) Partial Participation will be lost
   [Not possible to insert employees who are not manager of dept.]

Many : Many Relationship:



E_1 (A B C)

A
a_1
a_2
a_3
a_4
⇑
key

R (A D)

A	D
a_1	d_1
a_2	d_2
a_2	d_2
⇑	⇑
Not key	

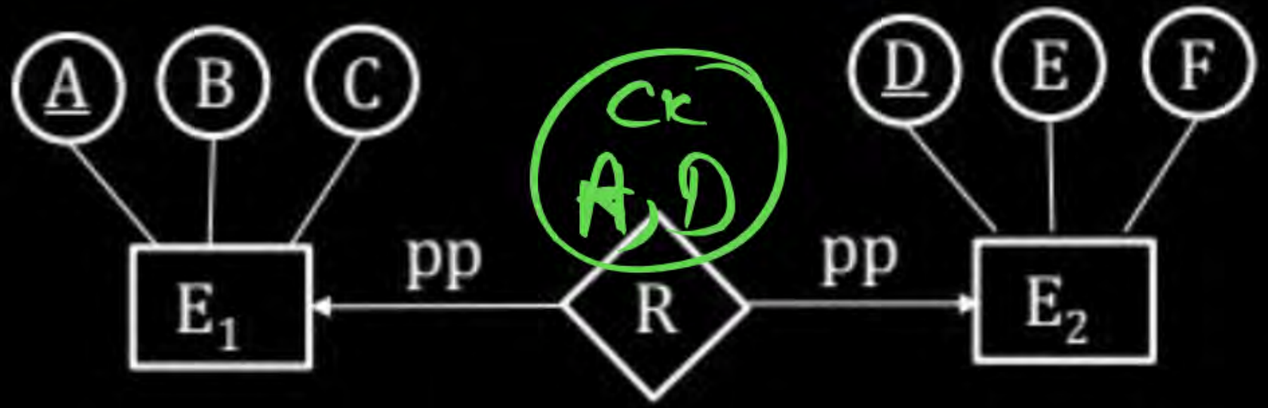
E_2 (D E F)

D
d_1
d_2
d_3
⇑
key

Minimum 3 relational table required and 2 foreign key required.

M:N relationship set not allowed to merge with any entity set.

One : One Relationship:



E_1 (A B C)

a_1
a_2
a_3
a_4
⇑
key
$[A \rightarrow BC]$

R (A D)

a_1	d_2
a_2	d_3
a_3	d_4
⇑	⇑
key	key
$[A \rightarrow D$	
$D \rightarrow A]$	

E_2 (D E F)

d_1
d_2
d_3
d_4
⇑
key
$[D \rightarrow EF]$

E_1, E_2 entity sets & R relationship set related between E_1 and E_2 with 1:1 cardinality and partial participation(pp) at both side.

① $E_1R(ABCD)$ $E_2(DEF)$

$A \rightarrow BCD$, $D \rightarrow EF$

OR

② $E_1(ABC)$ $RE_2(DEFA)$

$A \rightarrow BC$ $D \rightarrow EFA$

If all merge with single Table:

E_1RE_2

A	B	C	D	E	F
a_1	-	-	d_2	-	-
a_2	-	-	d_3	-	-
a_3	-	-	d_4	-	-
a_4	-	-	Null	Null	Null
Null	NULL		d_1	-	-

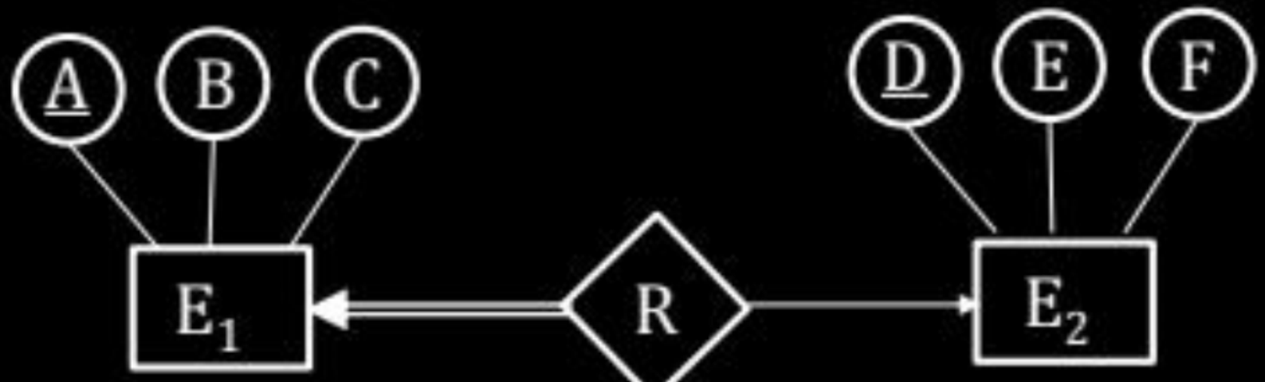
Candidate key = {A, D}

No Candidate key is present, & No primary key

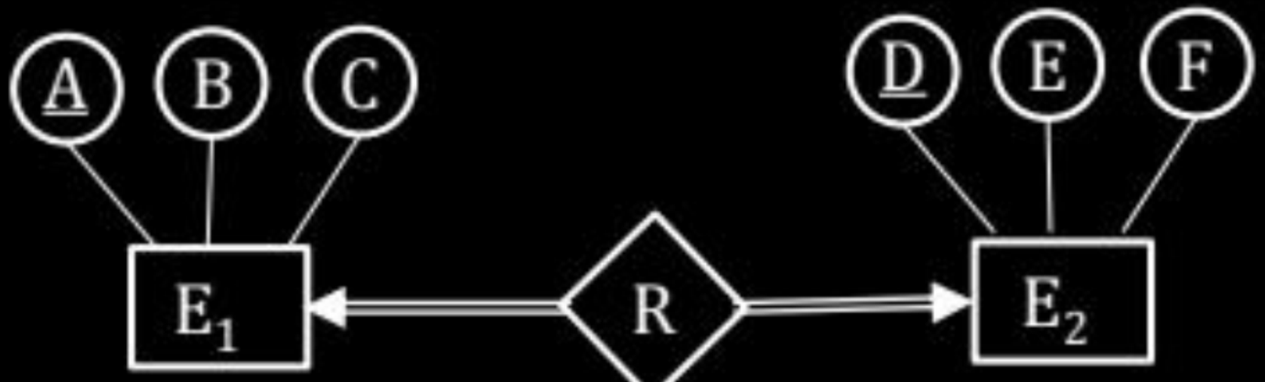
A relational table in which no attribute having "NOT NULL" values are "NOT" allowed in RDBMS . So,

- minimum 2 Relation Table Required and 1 Foreign key.

E_1 E_2 Entity set R Rel set between E_1E_2
With 1:1 mapping and at least one end having total participation.



E_1 R E_2 (A B C D E F)

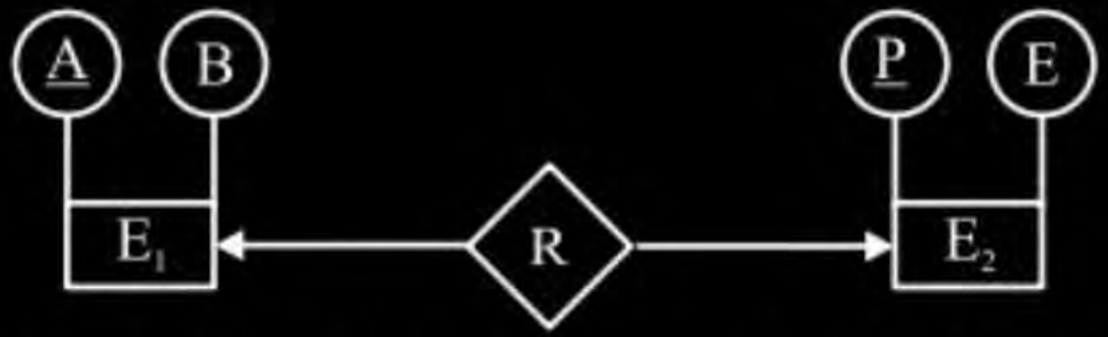


E_1 R E_2 (A B C D E F)

Primary Key

UNIQUE & NOT NULL (Alternative Key)

Q.



70% participation at E_1 end & 40% participation at E_2 end.
Which is best possible design?

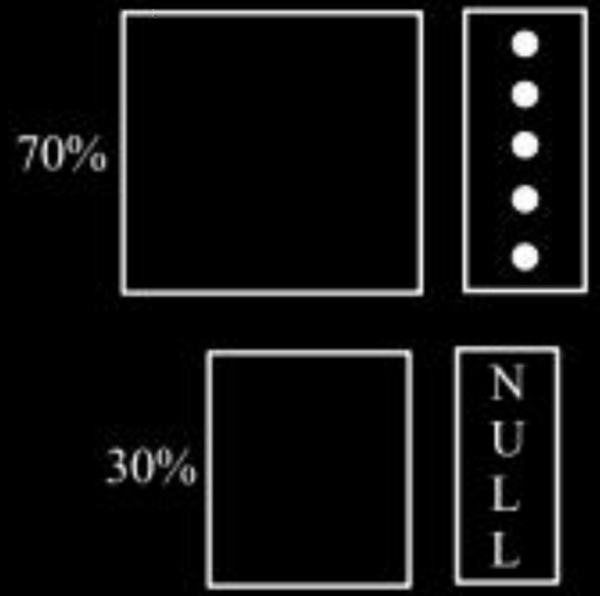
A. E_1 E_2 entity set kept separate with F.K at E_1

B. E_1 E_2 entity set kept separate with F.K at E_2

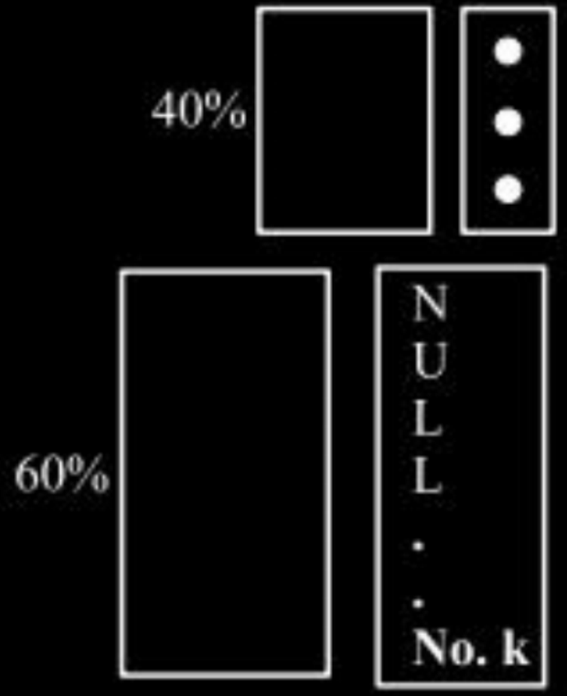
C. E_1 E_2 entity set kept separate with F.K at both E_1 E_2

D. E_1 E_2 merges into single table with No F.K.

(a) E_1 R (A B D) E_2 (D E)

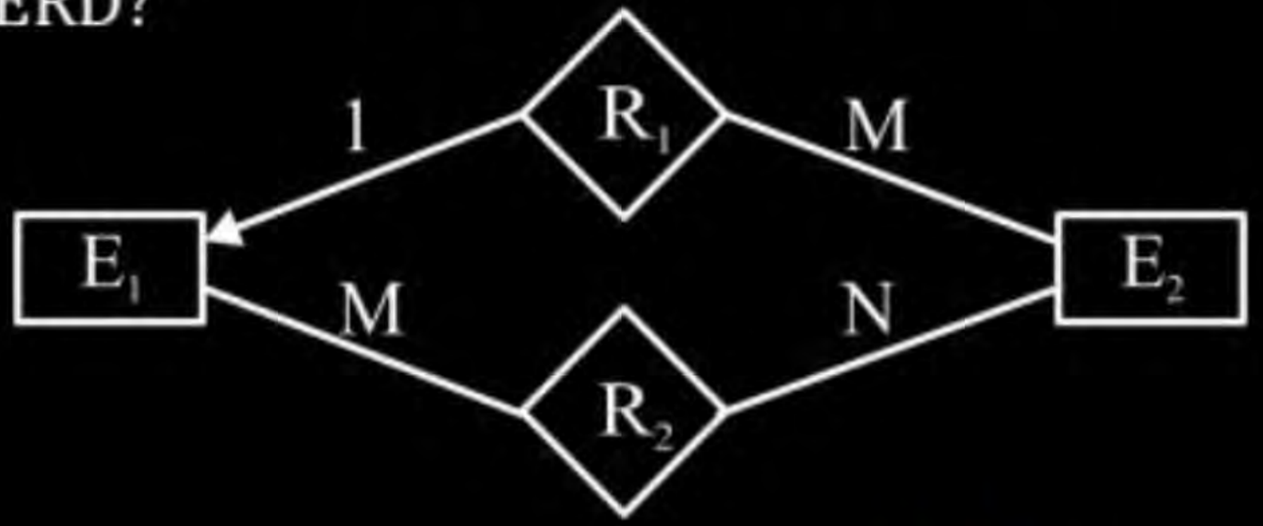


(b) E1(A, B) E_2 (D E A)



Q.

E_1 E_2 entity set R_1 R_2 Relationship set related between E_1 and E_2 with 1:M and M : N mapping min Relational Table required in ERD?



A. 2

B. 3

C. 4

D. 5

Q.

$E_1E_2E_3$ entity set R_1 Relation between E_1 E_2 with 1 : M, R_2 Relations between E_2 E_3 with M : 1, R_3 Relationship between E_1 & E_3 with M : N

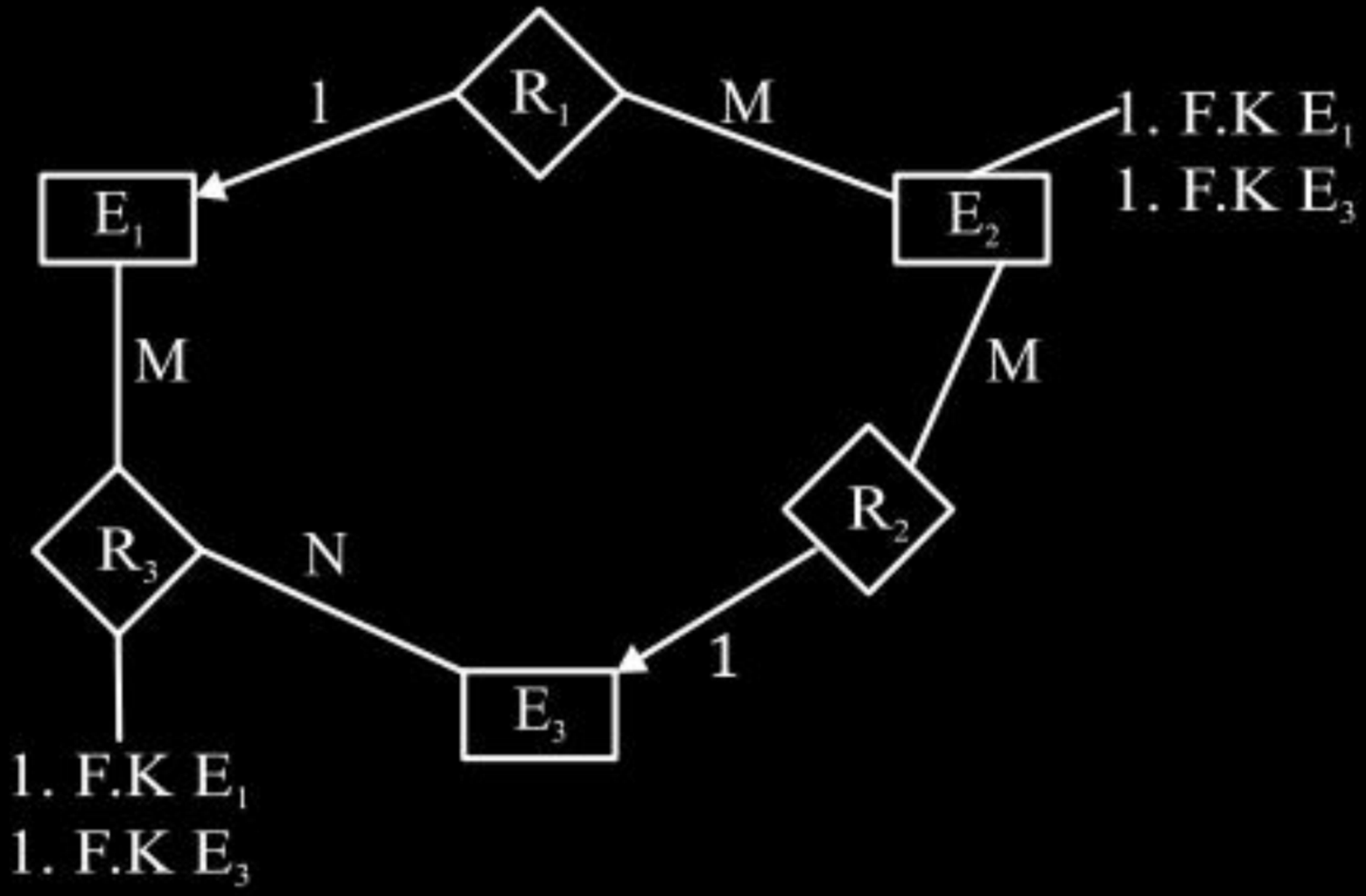
How many minimum relational tables required for given ERD?

A. 2

B. 3

C. 4

D. 5



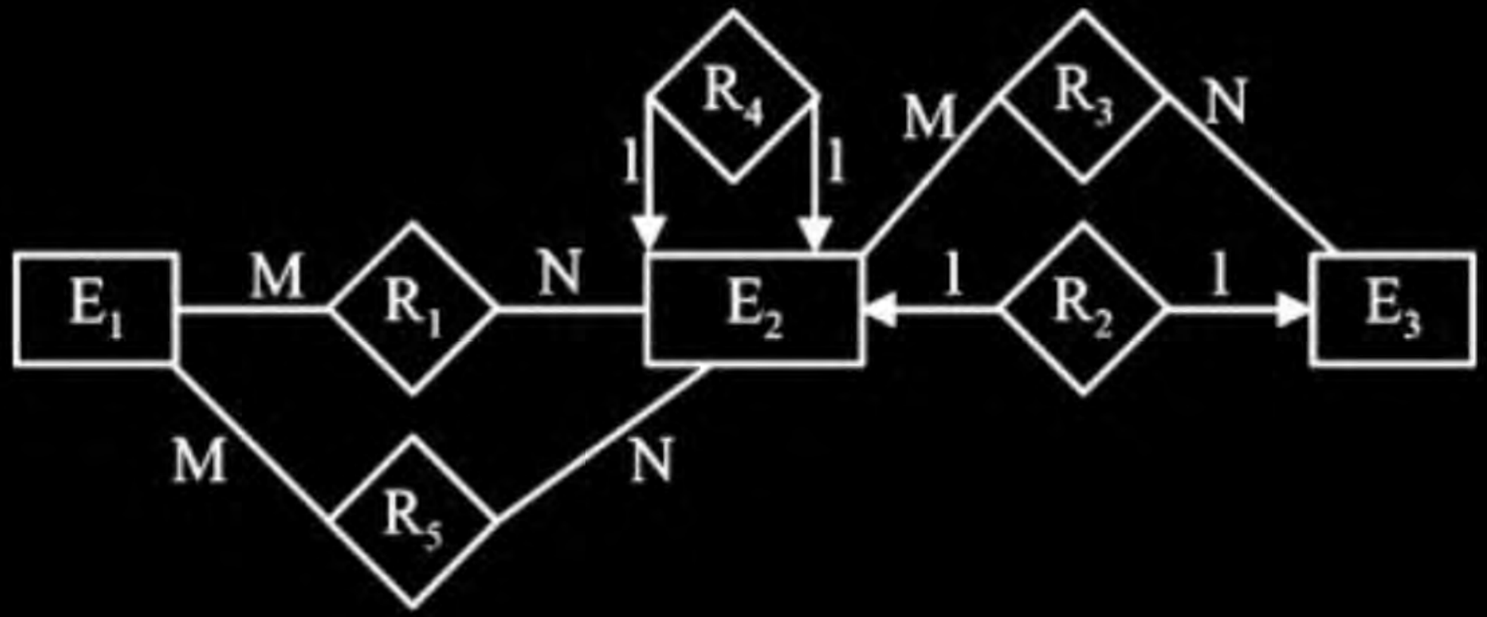
Min 4 Rel Table and 4 Foreign key.

Q.

[NAT]

Consider the following ER diagram

Total number of RDBMS table in the above diagram?



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

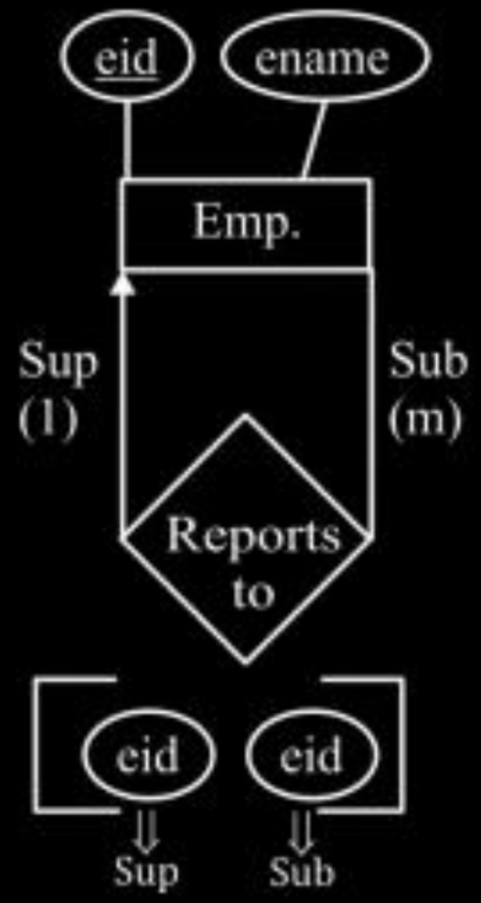
} Self Referential Relationship set.

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

⇒ Emp entity set.

Reports to Relationship Set Related between Supervisor and Subordinate

(i) Each supervisor can supervise many subordinates and each subordinate reports to one supervisor.



Emp.	(eid	ename)
	e1	–
	e2	–
	e3	–
	e4	–

Reports to	(Sup		Sub)
	e1	–	e2
	e1	–	e3
	e2	–	e4

Emp.	(eid	ename)
	e1	–
	e2	–
	e3	–
	e4	–

Reports to	(Sup		Sub)
	e1	–	e2
	e1	–	e3
	e2	–	e4

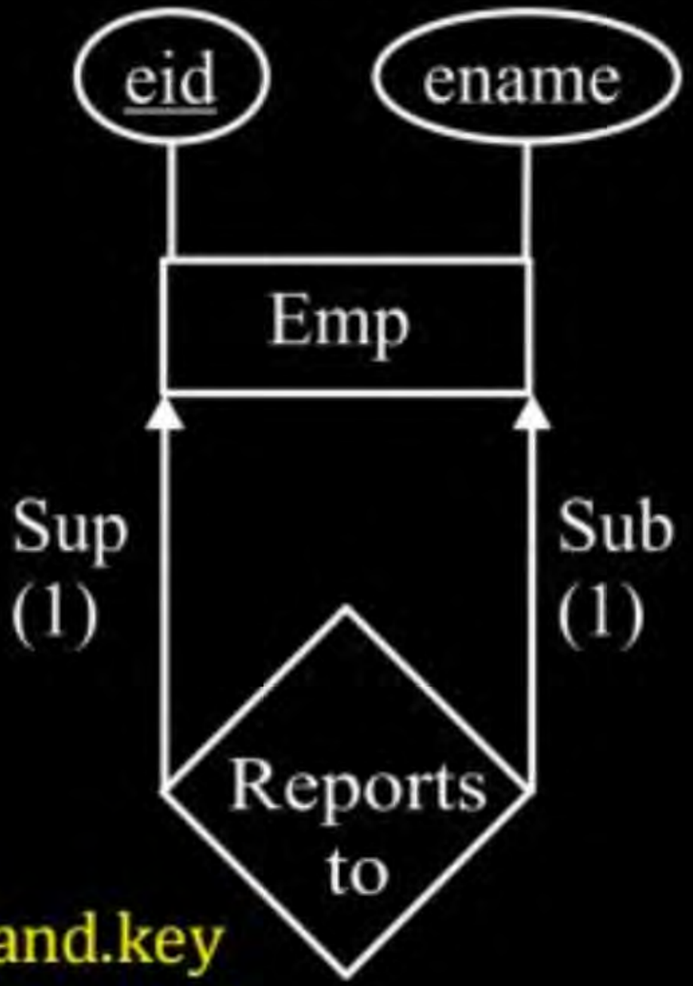
(eid + sub) ⇓ Combine

Cand. Key; {eid}
"Sup" Foreign key Ref.
to same table

Emp. Reports to	(eid		ename Sup)
	e_1	→	Null
	e_2	→	e_1
	e_3	→	e_1
	e_4	→	e_2

Min 1 RDBMS table required with 1 F.K refer to same table

(ii) Each supervisor can supervise one subordinates and each subordinate reports to one supervisor



Cand.key
{sup, sub}

Emp. (<u>eid</u> ename)

e1 –
e2 –
e3 –
e4 –

Reports to (Sub Sub)

e1	–	e2
e2	–	e3
e3	–	e4

Emp_Report to — Merge — Emp_Reports to (eid, ename, Sup)

eid		Sup
e_1	→	Null
e_2	→	e_1
e_3	→	e_2
e_4	→	e_3

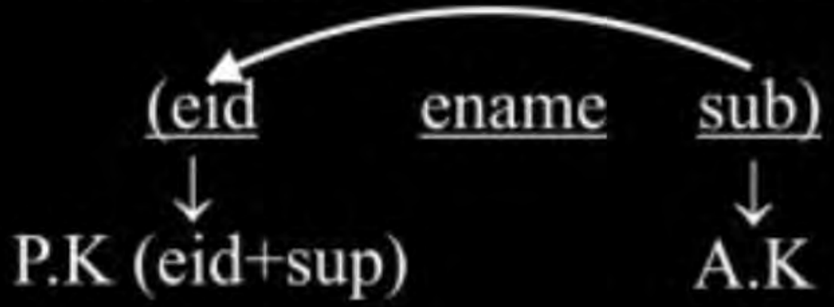
Can. Key : {eid, sub}

eid ⇓ P.K. (eid + sub)

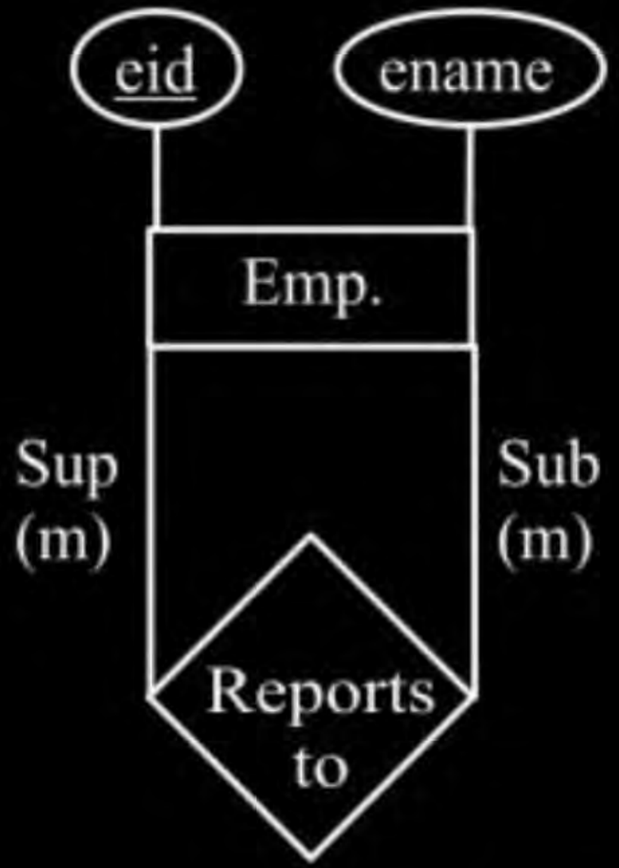
sub ⇓ A.K

"Sup" foreign key Refers to same Table eid.

Or one more possibilities



(iii) Each supervisor can supervise many subordinate and each subordinate reports to many supervisor.



Emp. (eid, ename)

eid	ename
e1	–
e2	–
e3	–
e4	–

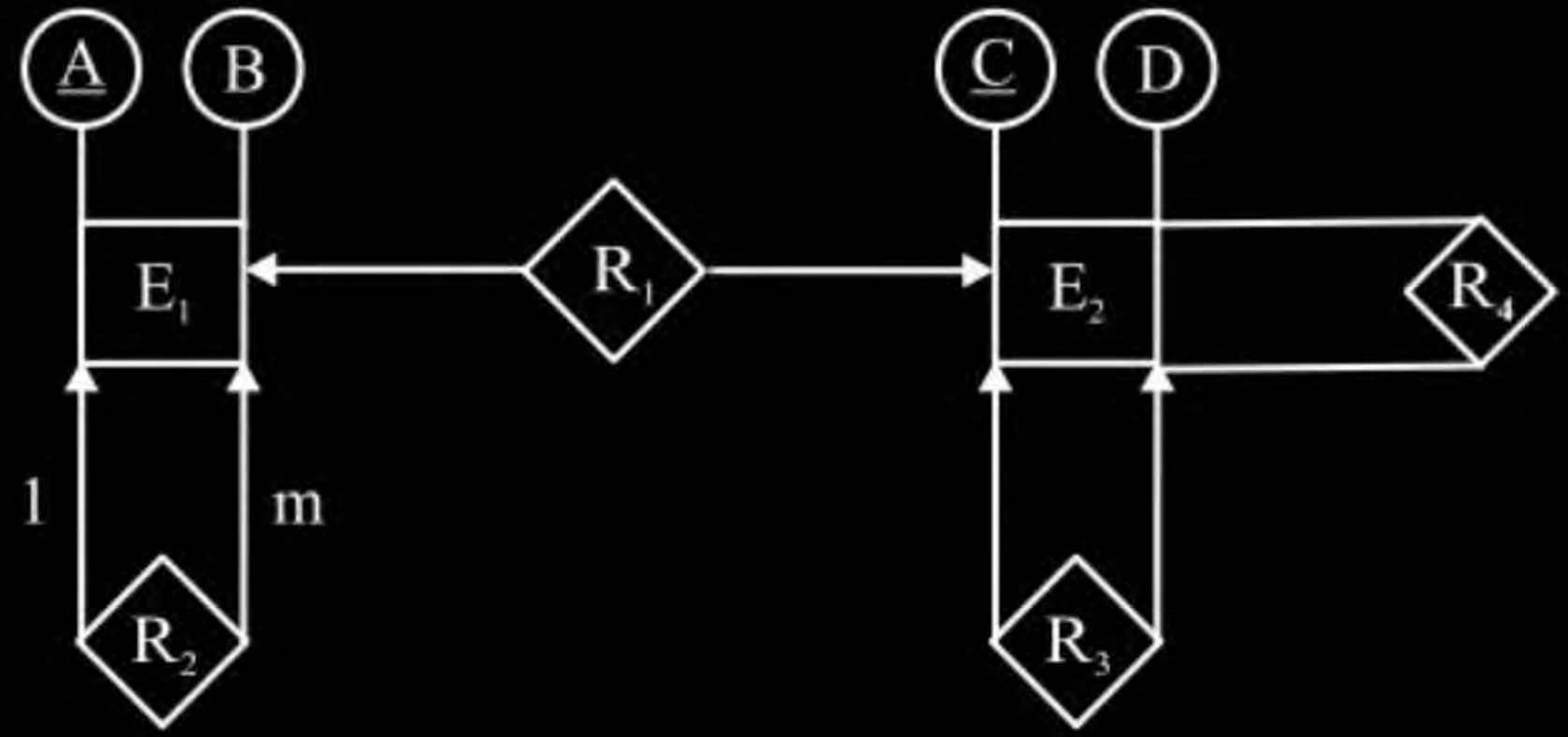
Reports to (Sub, Sub)

Sub		Sub
e2	–	e2
e1	–	e3
e2	–	e3

Cand.key {sup sub}

Minimum 2 relational table and 2 foreign keys.

Q.



(I) $E_1\ R_2\ (\underline{A}\quad B\quad A)$

(II) $E_2\ R_1\ R_3\ (\underline{C}\quad D\quad A\quad C)$

(III) $R_4\ C_3\ C_4$

Q.

[MCQ]

Consider the following ER diagram:

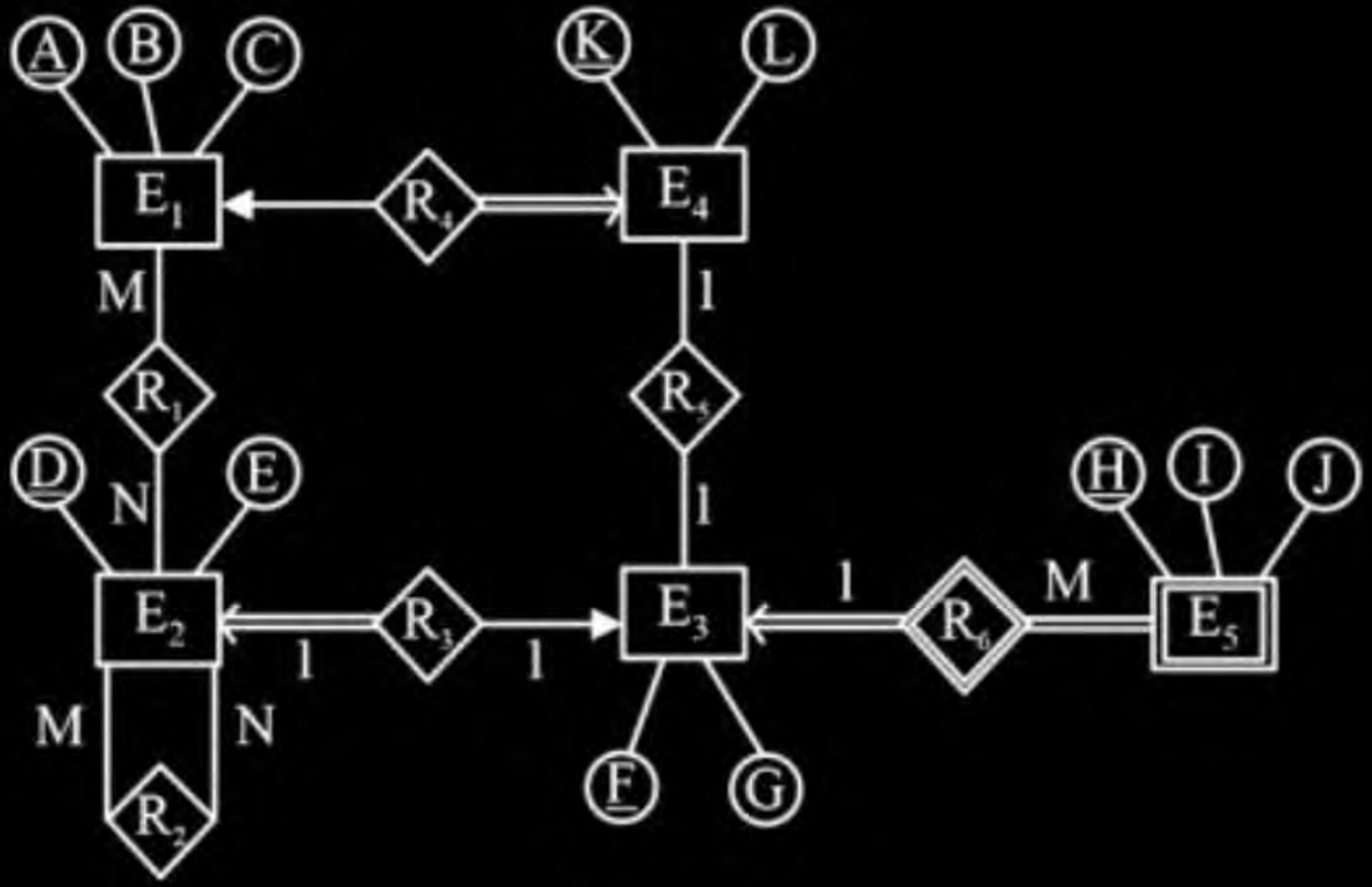
How many total attributes required for the minimized relations of the above ER diagram?

A. 14

B. 15

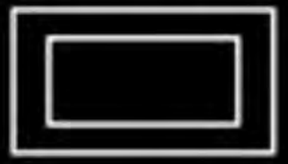
C. 18

D. None of these

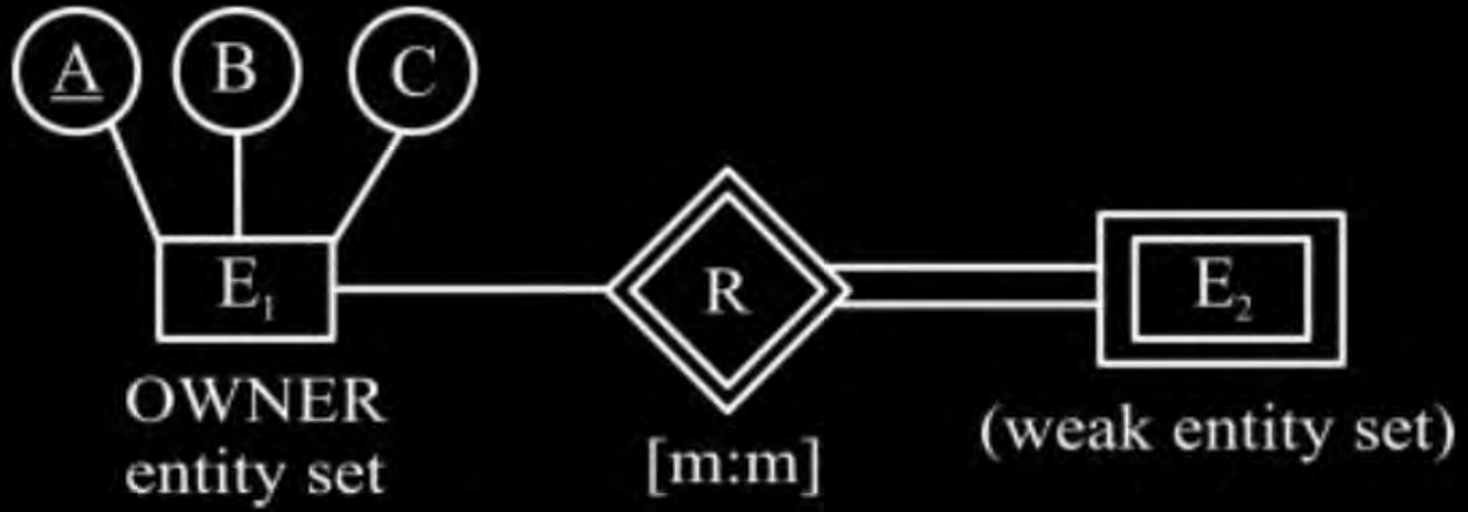


WEAK ENTITY SET:

⇒ Entity set with no key.
[Attributes of weak entity set not sufficient to differentiate entities uniquely]

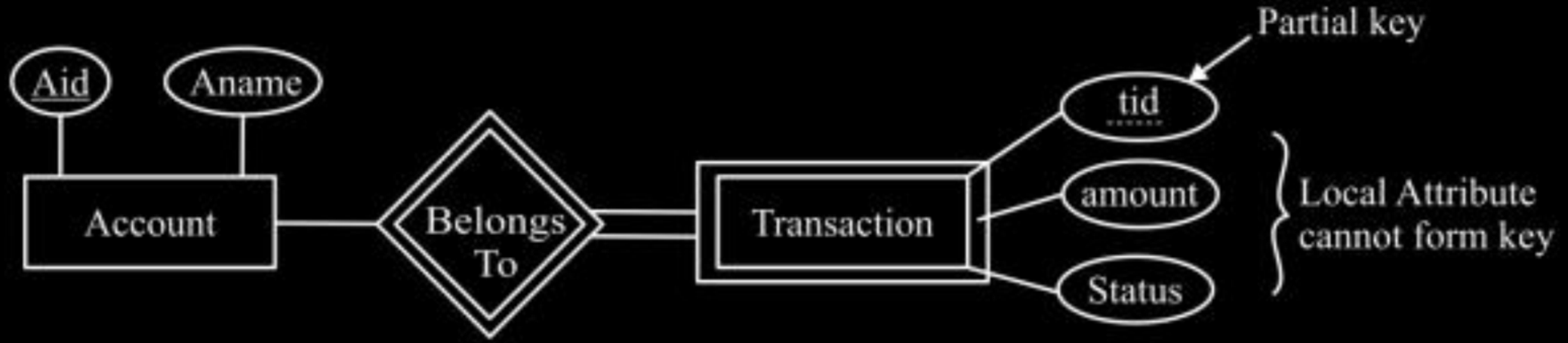
⇒ 

⇒ For each weak entity set there must be OWNER entity set which is strong entity.



⇒ Entities of weak entity set are depending entities.

Ex.



Aid tid

Aid	tid
A_1	t_1
A_2	t_1
A_2	t_2
A_3	t_2

Aid	Aname
A_1	
A_2	
A_3	
A_4	

Transaction

tid	amount	Status
t_1	5000	Debit
t_1	4000	Credit
t_2	5000	Debit
t_2	5000	Debit

⇑

[1: m]

Ambiguity

- Relationship set between weak entity set and identifier entity is also weak relationship set.

- Participation towards weak entity set end must be TOTAL PARTICIPATION.
- Mapping between identifier set must be one: many (1: m)
- RDBMS Design:
  Transaction belongs (Aid tid amount state)
  Account (Aid Aname)

NOTE: Weak entity set and multivalued attributes allowed to represent in ERD, but NOT allowed in RDBMS Table.

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 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

MCQ **Q.1**

In an Entity-Relationship (ER) model, suppose R is a many-to-one relationship from entity set E1 to entity set E2. Assume that E1 and E2 participate totally in R and that the cardinality of E1 is greater than the cardinality of E2.

Which one of the following is true about R?

[GATE-2018-CS: 1M]

A. Every entity in E1 is associated with exactly one entity in E2.

B. Some entity in E1 is associated with more than one entity in E2.

C. Every entity in E2 is associated with exactly one entity in E1.

D. Every entity in E2 is associated with at most one entity in E1.

NAT **Q.2**

Consider an Entity-Relationship (ER) model in which entity sets E_1 and E_2 are connected by an m: n relationship R_{12} . E_1 and E_3 are connected by a 1: n (1 on the side of E_1 and n on the side of E_3) relationship R_{13}.

E_1 has two single-valued attributes a_{11} and a_{12} of which a_{11} is the key attribute. E_2 has two single valued attributes a_{21} and a_{22} of which a_{21} is the key attribute. E_3 has two single valued attributes a_{31} and a_{32} of which a_{31} is the key attribute. The relationships do not have any attributes.

If a relational model is derived from the above ER model, then the minimum number of relations that would be generated if all the relations are in 3 NF is_____

[GATE-2015-CS: 2M]

MCQ **Q.3**

Consider the following statements S1 and S2 about the relational data model:

S1: A relation scheme can have at most one foreign key.

S2: A foreign key in a relation scheme R cannot be used to refer to tuples of R.

Which one of the following choices is correct?

[GATE-2021-CS: 1M]

A. Both S1 and S2 are true

B. S1 is true and S2 is false

C. S1 is false and S2 is true

D. Both S1 and S2 are false

NAT Q.4

Consider the following tables T1 and T2.

In table T1, **P** is the primary key and **Q** is the foreign key referencing **R** in table T2 with on-delete cascade and on-update cascade. In table T_2, **R** is the primary key and **S** is the foreign key referencing **P** in table T1 with on-delete set NULL and on-update cascade. In order to delete record ⟨3,8⟩ from table T1, the number of additional records that need to be deleted from table T1 is

T_1	
P	**Q**
2	2
3	8
7	3
5	8
6	9
8	5
9	8

T_2	
R	**S**
2	2
8	3
3	2
9	7
5	7
7	2

[GATE-2017-CS: 1M]

MCQ Q.5

Let E_1 and E_2 be two entities in an E-R diagram with simple single-valued attributes. R_1 and R_2 are two relationships between E_1 and E_2, where R_1 is one-to-many and R_2 is many-to-many. R_1 and R_2 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model?

[GATE-2005]

A 2

B 3

C 4

D 1

MCQ Q.6

Consider the entities 'hotel room', and 'person' with a many to many relationship 'lodging' as shown below:

If we wish to store information about the rent payment to be made by person (s) occupying different hotel rooms, then this information should appear as an attribute of [GATE-2005]

A Person

B Hotel Room

C Lodging

D None of these

MCQ Q.7

Amongst the ACID properties of a transaction, the 'Durability' property requires that the changes made to the database by a successful transaction persist

[GATE-2005]

A. Except in case of an Operating System crash

B. Except in case of a Disk crash

C. Except in case of a power failure

D. Always, even if there is a failure of any kind

MCQ **Q.8**

Consider the following schedules involving two transactions. Which one of the following statements is TRUE?

$S_1 : r_1(X); r_1(Y); r_2(X); r_2(Y); w_2(Y); w_1(X)$

$S_2 : r_1(X); r_2(X); r_2(Y); w_2(Y); r_1(Y); w_1(X)$ [GATE-2007]

A. Both S_1 and S_2 are conflict serializable.

B. S_1 is conflict serializable and S_2 is not conflict serializable.

C. S_1 is not conflict serializable and S_2 is conflict serializable.

D. Both S_1 and S_2 are not conflict serializable.

MCQ Q.9

Consider the following log sequence of two transactions on a bank account, with initial balance 12000, that transfer 2000 to a mortgage payment and then apply a 5% interest.

1. T1 start
2. T1 B old=12000 new=10000
3. T1 M old=0 new=2000
4. T1 commit
5. T2 start
6. T2 B old=10000 new=10500
7. T2 commit

Suppose the database system crashes just before log record 7 is written. When the system is restarted, which one statement is true of the recovery procedure?

[GATE-2006]

A We must redo log record 6 to set B to 10500

B We must undo log record 6 to set B to 10000 and then redo log records 2 and 3.

C We need not redo log records 2 and 3 because transaction T1 has committed.

D We can apply redo and undo operations in arbitrary order because they are idempotent

MCQ Q.10

Which one of the following statements about normal forms is FALSE?

[GATE-2005]

A. BCNF is stricter than 3NF

B. Lossless, dependency-preserving decomposition into 3NF is always possible

C. Lossless, dependency-preserving decomposition into BCNF is always possible

D. Any relation with two attributes is in BCNF

MCQ Q.11

A table has fields F_1, F_2, F_3, F_4, F_5 with the following functional dependencies

- $F_1 \rightarrow F_3$, $F_2 \rightarrow F_4$, $(F_1 . F_2) \rightarrow F_5$

In terms of Normalization, this table is in

[GATE-2005]

A 1 NF

B 2 NF

C 3 NF

D none

MCQ Q.12

Consider two tables in a relational database with columns and rows as follows:

Table: Student

ROLL_NO	NAME	DEPT_ID
1	ABC	1
2	DEF	1
3	GHI	2
4	JKL	3

Table: Department

DEPT_ID	DEPT_NAME
1	A
2	B
3	C

Roll_no is the primary key of the Student table, Dept_id is the primary key of the Department table and Student.Dept_id is a foreign key from Department.Dept_id
What will happen if we try to execute the following two SQL statements?

i. update Student set Dept_id = Null where Roll_on = 1

ii. update Department set Dept_id = Null where Dept_id = 1

[GATE-2004]

A Both (i) and (ii) will fail

B (i) will fail but (ii) will succeed

C (i) will succeed but (ii) will fail

D Both (i) and (ii) will succeed

MCQ Q.13

Which of the following scenarios may lead to an irrecoverable error in a database system?

[GATE-2003]

A. A transaction writes a data item after it is read by an uncommitted transaction

B. A transaction reads, a data item after it is read by an uncommitted transaction

C. A transaction reads a data item after it is written by a committed transaction

D. A transaction reads a data item after it is written by an uncommitted transaction

MCQ_85 Q.14

Consider the following functional dependencies in a database.

Date_of_Birth→Age

Age → Eligibility

Name → Roll number

Roll_number → Name

Course_number → Course name

Course_number → Instructor

(Roll_number, Course_number) → Grade

The relation (Roll_number, Name, Date_of_birth, Age) is

[GATE-2003]

A in second normal form but not in third normal form

B in third normal form but not in BCNF

C in BCNF

D none of tire above

MCQ Q.15

Consider three data items D1, D2, and D3, and the following execution schedule of transactions T1, T2, and T3. In the diagram, R(D) and W(D) denote the actions reading and writing the data item D respectively,

[GATE-2003]

T1	T2	T3
	R(D3);	
	R(D2);	
	W(D2);	
		R(D2);
		R(D3);
R(D1);		
W(D1);		
		W(D2);
		W(D3);
	R(D1);	
R(D2);		
W(D2);		
	W(D1);	

Which of the following statements is correct?

A The schedule is serializable as T2; T3; T1

B The schedule is serializable as T2 ; T1 ; T3

C The schedule is serializable T3 ; T2 ; T1

D The schedule is not serializable

Descriptive Q.16

For relation R =(L, M, N, O, P), the following dependencies hold:
$M \rightarrow O$, $NO \rightarrow P$, $P \rightarrow L$, and $L \rightarrow MN$
R is decomposed into R_1=(L, M, N, P) and R_2 = (M, O).

a Is the above decomposition a lossless-join decomposition? Explain.
b Is the above decomposition dependency-preserving ? If not ,list all the dependencies that are not preserved.
c. What is the highest normal form satisfied by the above decomposition? [GATE-2002]

MCQ **Q.17**

Consider a schema R(A,B,C,D) and functional dependencies $A \rightarrow B$ and $C \rightarrow D$.

Then the decomposition of R into $R_1(A, B)$ and $R_2(C, D)$ is

[GATE-2001]

(A) Dependency preserving and lossless join

(B) Lossless join but not dependency preserving

(C) Dependency preserving but not lossless join

(D) Not dependency preserving and not lossless join

MCQ Q.18

For a database relation R(a, b, c, d), where the domains a, b, c, d include only atomic values, only the following functional dependencies and those that can be inferred from them hold:

- $a \rightarrow c$
- $b \rightarrow d$

The relation is [GATE-1997]

(A) in first normal form but not in second normal form

(B) in second normal form but not in first normal form

(C) in third normal form

(D) none of the above

Descriptive Q.19

Consider the relation scheme R(A,B,C) with the following functional dependencies:

- $A, B \rightarrow C$
- $C \rightarrow A$

(a) Show that the scheme R is in Third Normal Form (3NF) but not in Boyce-Codd Normal Form (BCNF).

(b) Determine die minimal keys of relation R.

[GATE-1995]

Descriptive Q.20

Consider the following database relations containing the attributes

- Book-id
- Subject_Category_of_book
- Name_of_Author
- Nationality_of_Author

with Book_id as the primary key

a. What is the highest normal form satisfied by this relation?

b. Suppose the attributes Book_title and Author_address are added to the relation, and the primary key is changed to {Name_of _Author, Book _title}, What will be the highest normal form satisfied by the relation?

[GATE-1998]

THANK YOU!