DBMS

Gate Notes

Subject: DBMS (Database management system)

ER-Model

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S

Introduction to DBMS :

Types (Examples: Text, numbers, Images, videos, speech.)

Data — (def) Data is - (any fact that can be recorded)

Data
- 1. Text and number (Tradishal data base) — Data Base — (def) Data base is - (Collection of related data)
- 2. Multimidia data base.
- 3. Geographi Information system.
- 4. Realtime data base.
- 5. Data ware house. (Data huge)

DBMS — (def) DBMS is - Set of programs we to - (Define, Construct, manipulate)

DB + DBMS → DBS (Data base system)
(Book, pen)
(collection of data + set of program)

Models in DBMS : (Data Base design)

ER model

HL or conceptual model - CL (high level)

Relation model

Representational or implementation - RL

drawing chart

actual work

LL or physical data models - PL (low level)

• Introduction to ER model — (Entity-relationship model)

In ER-model - 3 thing should know

Person — (Thing) — Entity ✓

Name, age — (Properties) — Attributes ✓

Works for — (association) — Relationship ✓

→ Entity type — Entity

PERSON (Age, Name, add) — (26, Rakesh, ...)

ER ✓ → Relation table → Hard disk

• Attributes —

Composite vs simple attribute.
Single valued vs multivalued attribute.
Stored vs derived attribute.
Complex attribute. → (Composite + Multivalued).

Entity → Person.
Attribute → Name, Age (single valued), Add (multivalued), PNO (multivalued), Date of Birth (derived)

Name → FN, MN, Last Name (composite)

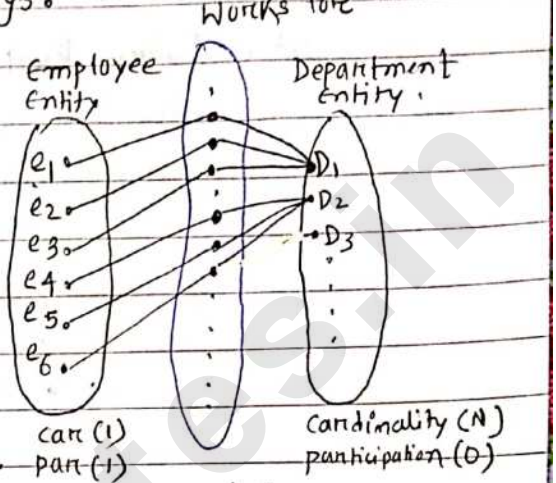
Add → (- - - -), (- - - - -) (complex attribute.)

Relationships =

⇒ association b/w entitys.

Example - 1 (1 to many)

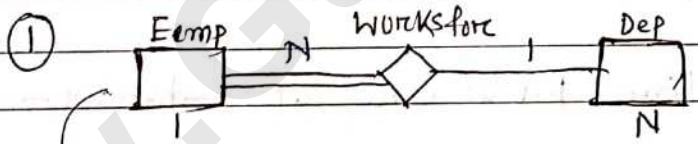
Requirement Analysis: (RA) Every employe Works for a Department, and a dep can have many employe. New dep need not have any employe.



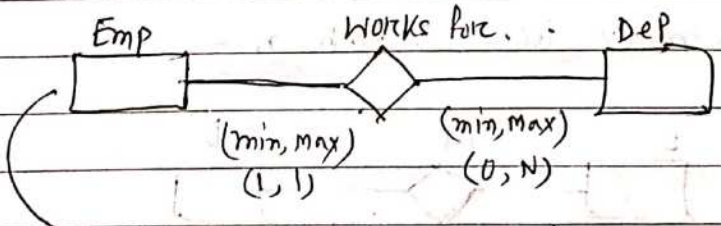
Degree: '2'

Structural constrain { cardinality ratio: Max relationship entity can participate.
participation or exsitence: ⇒ min relationship entity can paricipate.

- Entity represented by - □
- Relationship " - ◇



(Cardinality ratio / Single line / Double line representation of ER Diagram.

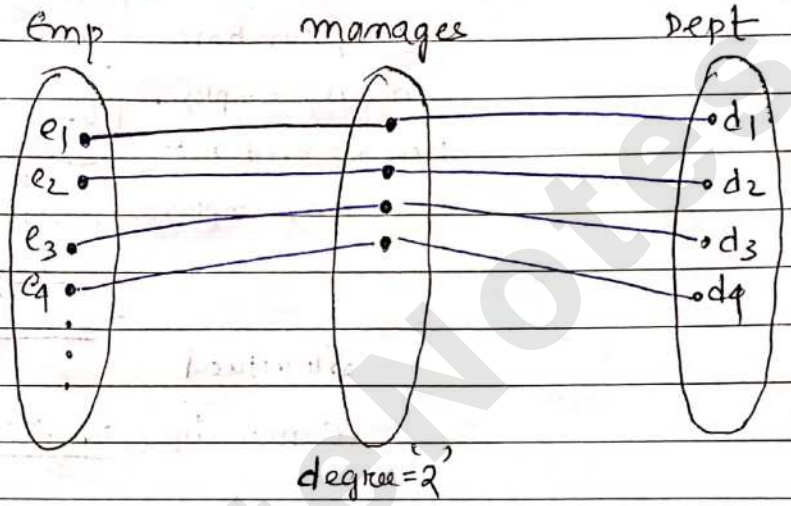


(Min Max representation of ER Diagram)

most info represent by

example-2 (1 to 1)

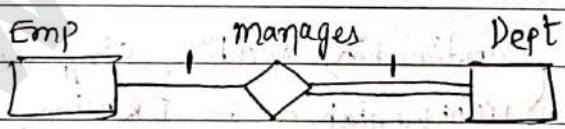
RA: Every Dept should have a manager and only one employee manages a dept and an employee can manage only one dept.



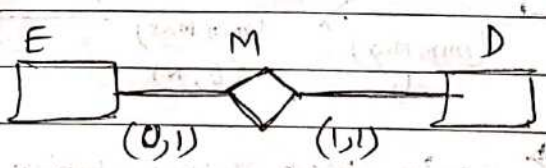
Cardinality: 1 ... 1

Participation: 0 (P) ... 1 (Total)

① Single line / Double line representation –

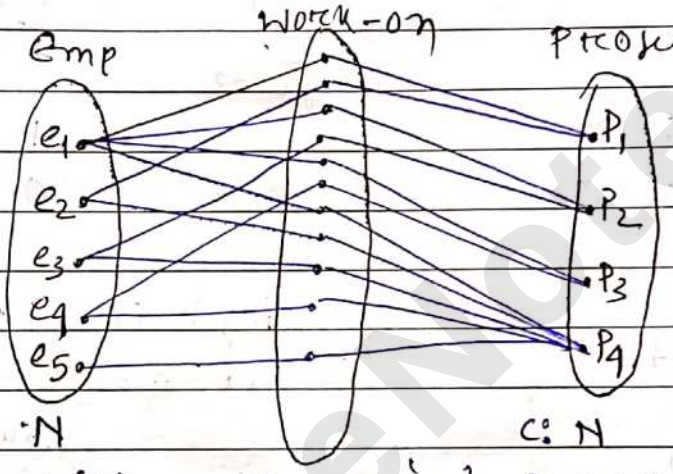


② Min max representation –



Example-3 (many to many)

RA: Every employ is suppose to work atleast on one project and he can work many project. Similarly a project have can have many employees and every project is suppose to have one employee.



C: N — degree = '2' — C: N
P: 1 (T) — P: 1 (T)

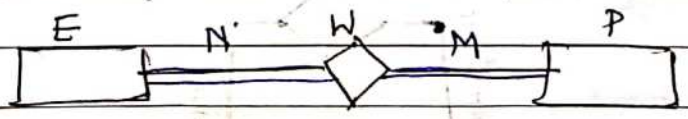
$P_1 = e_1\ e_2$

$P_2 = e_1\ e_3$

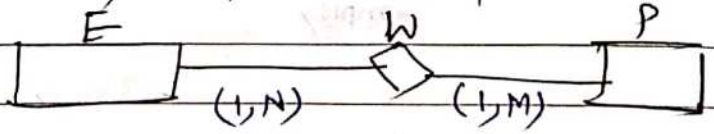
$P_3 = e_1\ e_4$

$P_4 = e_1\ e_2\ e_3\ e_4\ e_5$

(1) Single line / Double line representation —



(2) Min Max representation —



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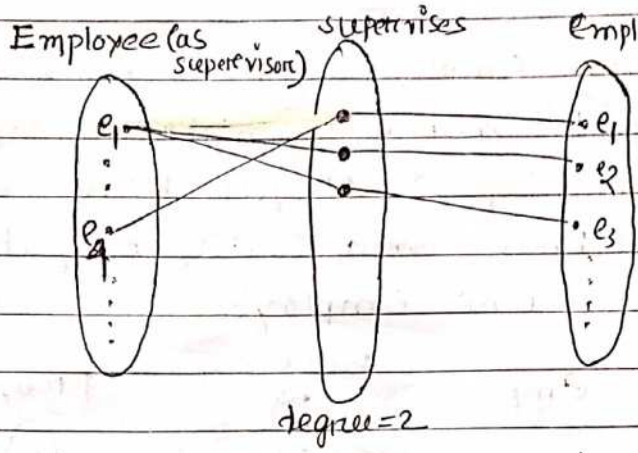
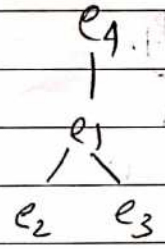
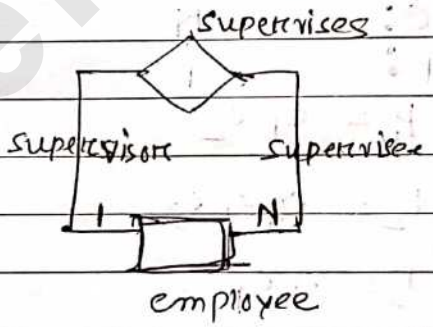
example-4 (Recursive relationship)



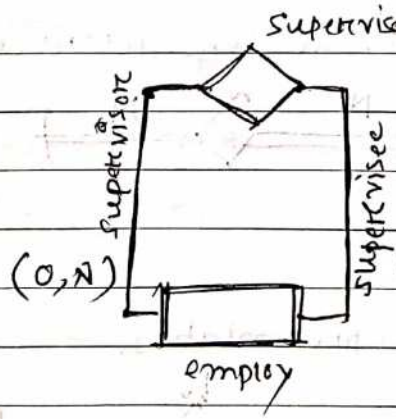
card : N — 1
part : O — O

① Single line / Double line representation -

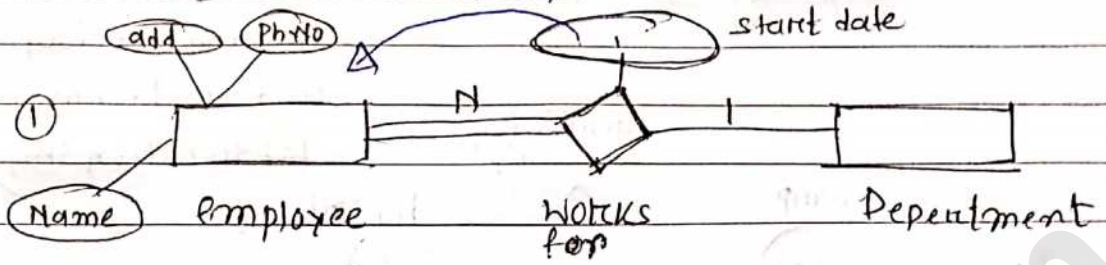


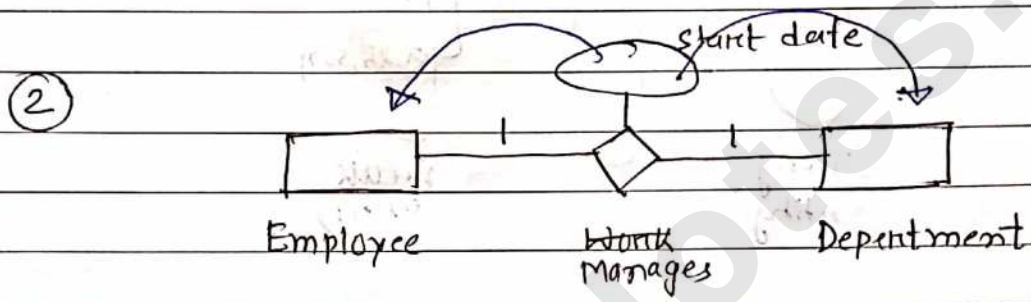


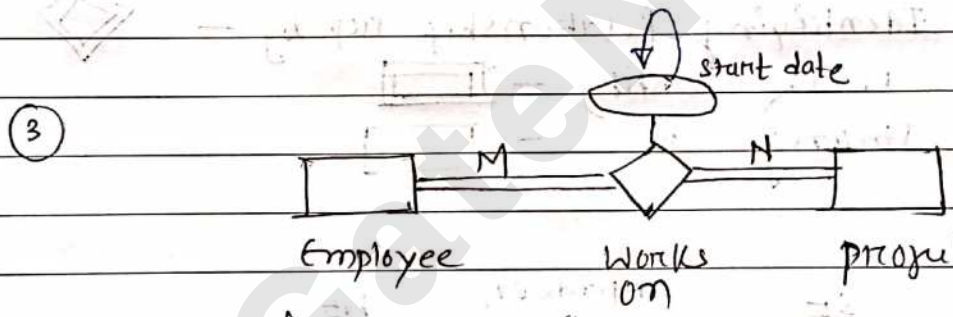
② Min Max representation of ER diagram -



• Attributes to relationships =







→ In this case Attribute can't shift any side, it will associate with relationship.

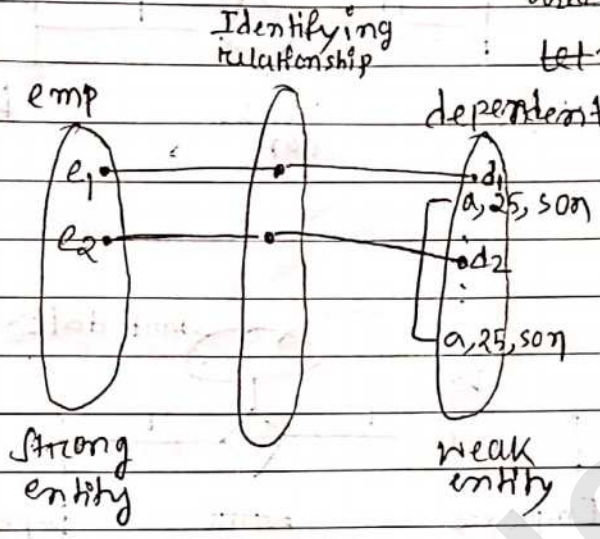
• Weak entity =

→ Whenever any entity not having key attribut then such entity called weak entity.

→ ~~What~~ entity having key attribut, then such entity called strong entity. (like, id no, Phone.NO, Reg NO).

Identifying Relationship :

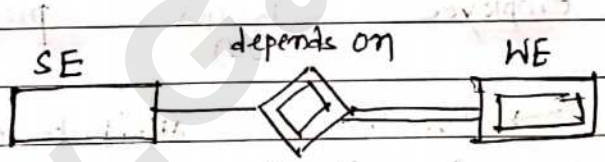
(~~Special~~ Special Relationship used to Identifying weak ~~let Relationship~~ entity)



→ Identifying Relationship rep by —

→ Weak entity —

→ Strong " —



→ Weak entity participation ~~in~~ Identifying relationship is total.

→ And Every Total Participation doesn't say that the entity is weak.

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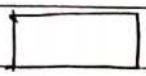
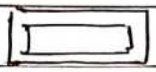
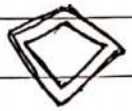
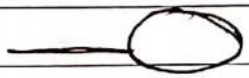
• ER-diagram notations —

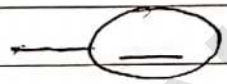
① Entity – 

② Weak Entity – 

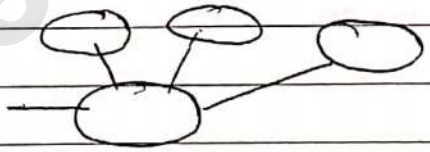
③ Relationship – 

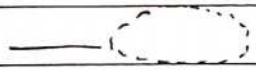
④ Identifying relation ship – 

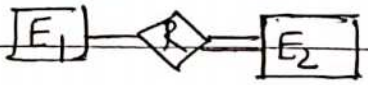
⑤ attribute – 

⑥ Key attribute – 

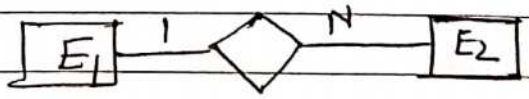
⑦ Multivalued attribute – 

⑧ composite attribute – 

⑨ Derived attribute – 

⑩ Total participation of E_2 in R – 

⑪ Cardinality ratio – $E_1 : E_2 = 1 : N$ –



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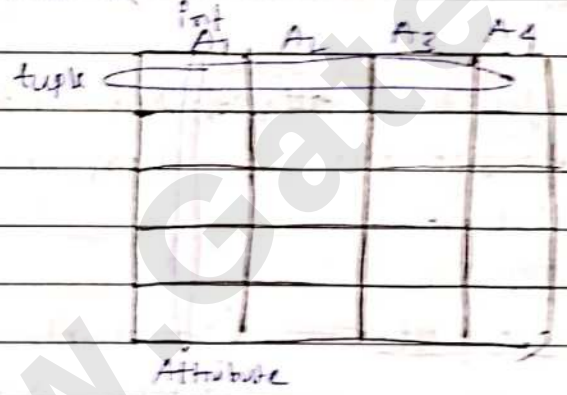
• Introduction to Relational model =

• Terminology of Relational database =

relation — (table)
tuple — (row)
attributes — (columns)
domain(s) — (Set of value) — (Data type)
relation schema — $R(A_1, A_2, A_3, A_4)$
degree of relation — (no. of attributes name in table)
relation state —
Intension — Some time relation schema is called intension.
extension — Table itself.
current relation state → (elements present in table at any given point of time.)

Table name - R



$R(A_1, A_2, A_3, A_4)$ — relation schema
$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow$
$D_1 \quad D_2 \quad D_3 \quad D_4$

$r(R) \subseteq D_1 \times D_2 \times D_3 \times D_4$

→ In relation model same two tuple can't place.

• Tuple, tuple value and NULL =

	Domain SN	SNO	PhNo
	a	1	201201
X	a	1	201201

→ two tuple (row) can't same.

FN (MN) LN (Ph)

not applicable / or / unknown → NULL

→ When in tuple (row) some attribute not (middle name, phone.NO) are not present, then in such case we use NULL.

• Relational Constraints. = (Constraints On Relational Database Schema)

4 - restriction (constraint) :

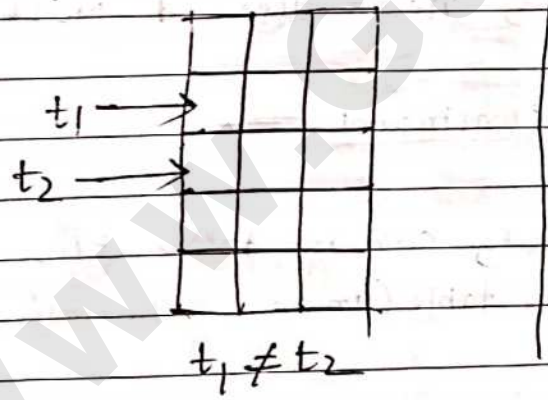
(1) Domain Constraints.
(2) Key Constraints. (also called uniqueness constraints)
(3) Entity integrity constraints.
(4) Referential integrity Constraints.

① Domain Constrains — (entire schema of attribute should atomic)

Student	Name			P.NO
S.No	FN	MN	LN	
				()()

atomic → Smallest individual unit.
→ every Domain should contain atomic value
→ Composite attribute not allowed only simple attribute are allowed.
→ multivalued attribute also not allowed.

② Key Constrains — (No two tuple can't be same value)



→ Super Key.

(S.No, S Name, marks)
1 Ravi 100
2

Super key ⊆ Attributes

(2) Key: minimal super-key

Name	Age	D.No	StreetNO

(1) Super Key: Set of Attribut able to findout tuple uniquly

here (Name, Doorno, street no) → Key.
→ In Worst Case superkey = Key.

(Relationship b/w Key and superKey)

→ any superset of a Key is a superKey.

(S.NO, SName) – SuperKey.
(S.NO, marks) – SuperKey
(S.NO, SName, mark) – SKey.

→ ~~In a table we more then one minimal~~

→ (3) Candidate Keys : If we have more then one key for a table.

(4) Primary Key : first choosen candidate key.

→ Key may contain more then one attribute.

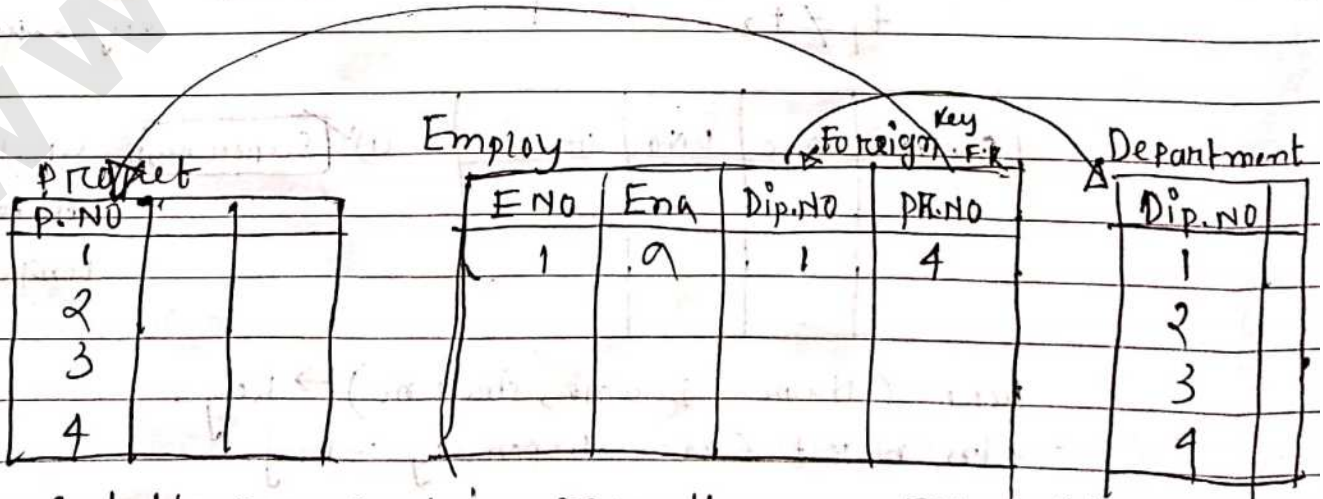
→ NULL value are not allow in primary key.

(3) Entity integrity constraints —

→ ~~here~~, primary key never allowed NULL value.

(4) Referential ~~Entity~~ integrity constraints —

→ Referential integrity can be define b/w two table or on the same table (in case of recursive relationship)



→ A table can contain more than one FK (Foreign Key).

• Actions Upon Constraint violations –

Operations of Data Base –
(I) insert. — (Reject)
(II) Delete.
(III) Update. (Modify)

Constraints –
(I) Domain
(II) Key
(III) Entity Integrity
(IV) Referential Integrity

(I) insertion :
When any of the constraints fail while Insert a key or tuple then ~~to~~ Reject the Insertion completly. (all constraints violated by ~~deletion~~ insertion)

(II) Deletion :
→ Domain constraints not violated by Deletion.
→ Key constraints also not " " " .
→ Entity Integrity " " " " "
→ (Only Referential Integrity violated by Deletion.)

Department

	D.NO	
x	1	
	2	

Employee

E.na	E.no	D.NO
a	3	1 (N)
		2

3 – solutions – to avoid Refere Integrity violations –
→ Reject action. (Deletion not possible)
→ Cascade (Delete from both ~~child~~ table)
→ set NULL or some other value.

(III) Update :
→ combination of Delete and Insert.
(Delete a old tuple & Insert new tuple)

- **Example-1**

Counting the number of Super keys possible:

- Counting the number of super keys possible:

Example - 1

given relation,

$R(A_1, A_2, A_3, \cdots A_n)$

candidate key = $\{A_1\}$
(minimal key)

$\rightarrow$ $R(A_1, A_2, A_3)$

$CK = A_1^{2 \times 2}$

$SK = \{A_1, A_1A_2, A_1A_3, A_1A_2A_3\}$

$= 2^{3-1}$ (2^{n-1})

$R(A_1, A_2, A_3 \cdots A_n)$

$2 \times 2 \times 2 \times \cdots \times 2$

no. of $SK = 2^{n-1}$

Example - 2

give, $R(A_1, A_2, A_3, \cdots A_n)$

$CK = A_1A_2$

$\Rightarrow$ $R(A_1, A_2, A_3, A_4, \cdots A_n)$

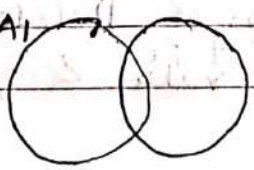
$2 \times 2 \times \cdots 2$

$\rightarrow$ $CK = A_1A_2$ — $SK = 2^{n-2}$

$CK = A_1A_2A_3$ — $SK = 2^{n-3}$

$\Rightarrow$ $CK = \{A_1, A_2\}$ — $[SK(A_1) + SK(A_2) - SK(A_1 \cap A_2)]$

$= 2^{n-1} + 2^{n-1} - 2^{n-2}$



Date :

Example – 3

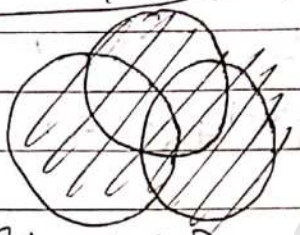
given, $R(A_1, A_2, A_3, \ldots A_n)$

(I) $CK = \{A_1, A_2, A_3\}$

$\rightarrow SK(A_1) + SK(A_2) + SK(A_3) - SK(A_1A_2A_3)$

$\rightarrow 2^{n-1} + 2^{n-2} + 2^{n-3}$

$SK \rightarrow (2^{n-1} + 2^{n-2} + 2^{n-3}) \Rightarrow$



(II) $CK = \{A_1, A_1A_2\}$

(III) $\rightarrow CK = \{A_1A_2, A_3A_4\}$

$\rightarrow SK(A_1A_2) + SK(A_3A_4) - SK(A_1A_2A_3A_4)$

$\rightarrow 2^{n-2} + 2^{n-2} - 2^{n-4}$

$SK \Rightarrow (2^{n-1} - 2^{n-4})$

(IV) $CK = \{A_1A_2, A_1A_3\}$

$SK = SK(A_1A_2) + SK(A_1A_3) - SK(A_1A_2A_3)$

$= 2^{n-2} + 2^{n-2} - 2^{n-3}$

$SK = (2^{n-1} - 2^{n-3})$

Example - 4

$R(A_1, A_2, A_3, \cdots A_n)$

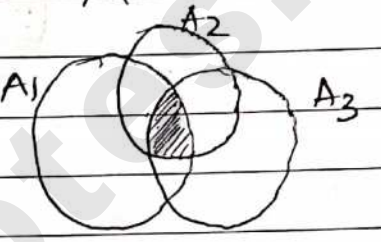
$CK = (A_1, A_2, A_3)$

$\rightarrow SK = SK(A_1) + SK(A_2) + SK(A_3) - SK(A_1A_2) - SK(A_2A_3) - SK(A_1A_3) + A_1A_2A_3$

$SK = 2^{n-1} + 2^{n-1} + 2^{n-1} - 2^{n-2} - 2^{n-2} - 2^{n-2} + 2^{n-3}$

$= 2 \cdot 2^{n-1} - 2 \cdot 2^{n-2} + 2^{n-3}$

$= 2^n - 2^{n-1} + 2^{n-3}$



No of super key possible.

$R(A, B, C, D)$

$CK = (A, BC)$

$SK = S(A) + S(BC) - S(ABC)$

$= 2^3 + 2^2 - 2^{4-3}$

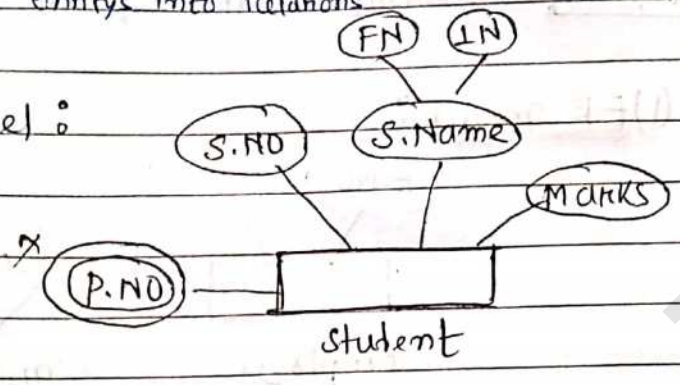
$= 8 + 4 - 2$

$= 10$ super key possible.

Conversion of ER model to Relation model

Step : 1 :: "convert entitys into relations"

ER model :



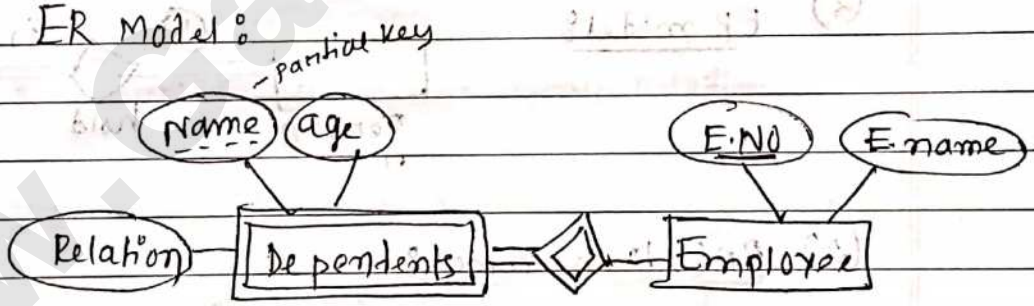
Relation model :

Student

S.NO	MARKS	FN	LN

Step-2 : "convert weak entity into Relation"

ER Model :



Relation as model :

Dependent

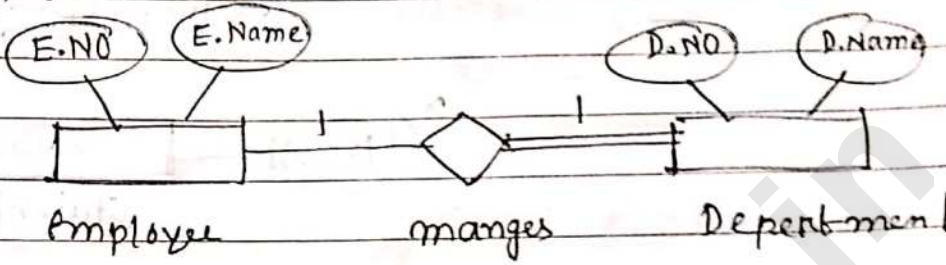
FK E.NO	Name	Age	Relation

Employee

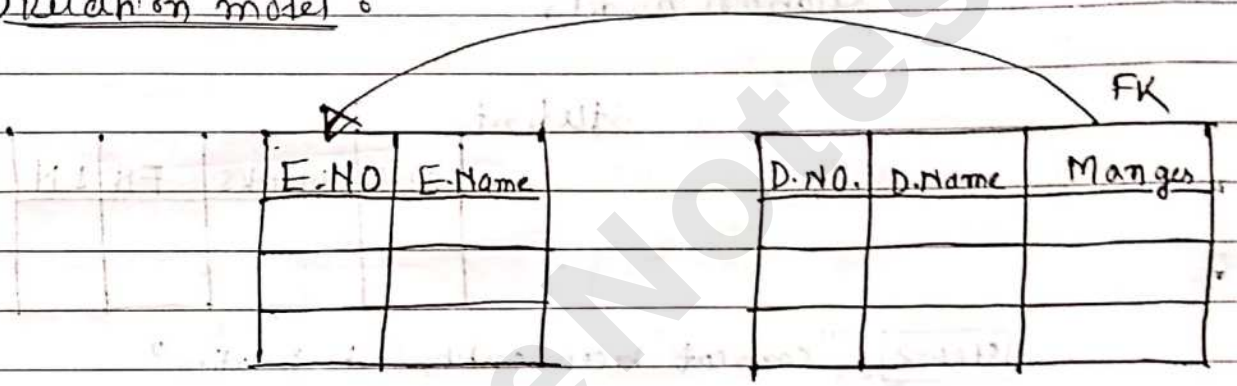
E.NO	E.name

Step-3 : "Convert Relationship into Relation"

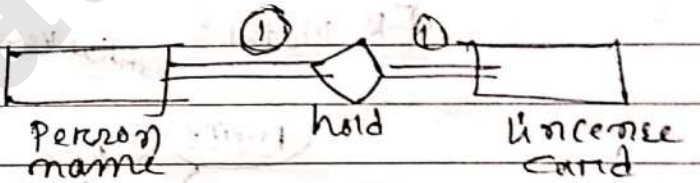
(1) ER model :



(1) Relation model :



(2) ER model :



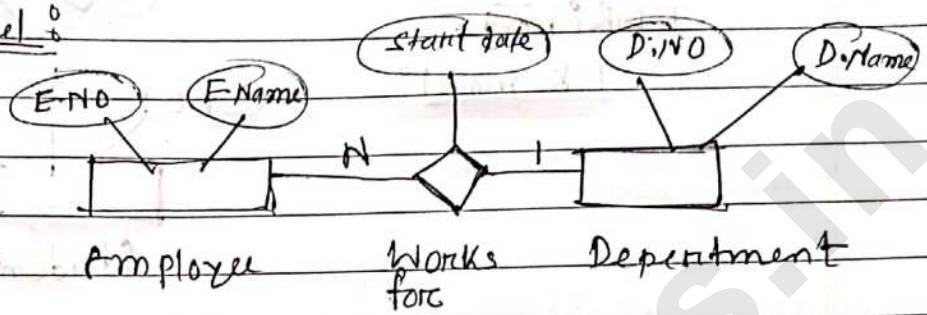
(2) Relation model :

(both side participate totaly)
Combine them in one Relation (table)

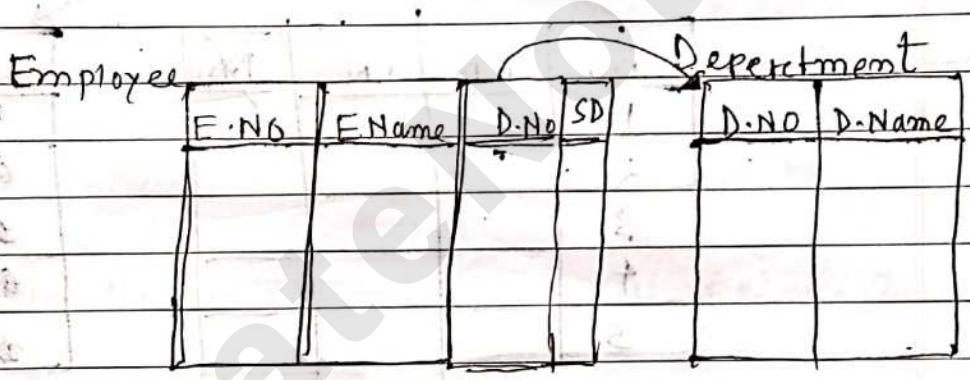
person name	Licence

Step - 4 : " convert one to n relationship in table (Relation) "

ER Model :

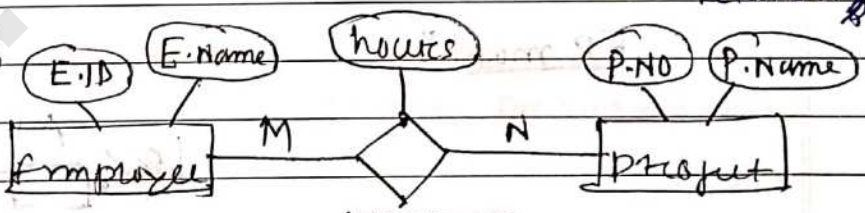


Relation model :



Step - 5 : " convert many to many relationship into relation "

ER model :



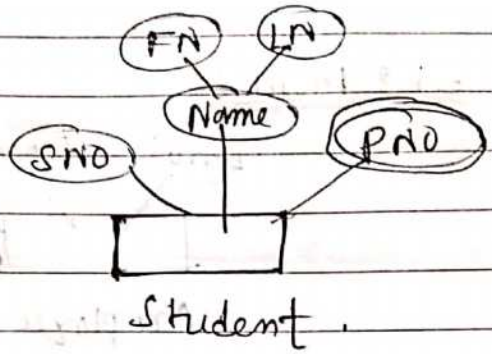
E.ID	E.Name
1	a
2	
3	
4	

P.NO	P.Name
1	b
2	c
3	d
4	e

E.ID	P.NO
1	1
1	2
1	3
2	1

Step-6 : "multivalued attributes"

ER model :



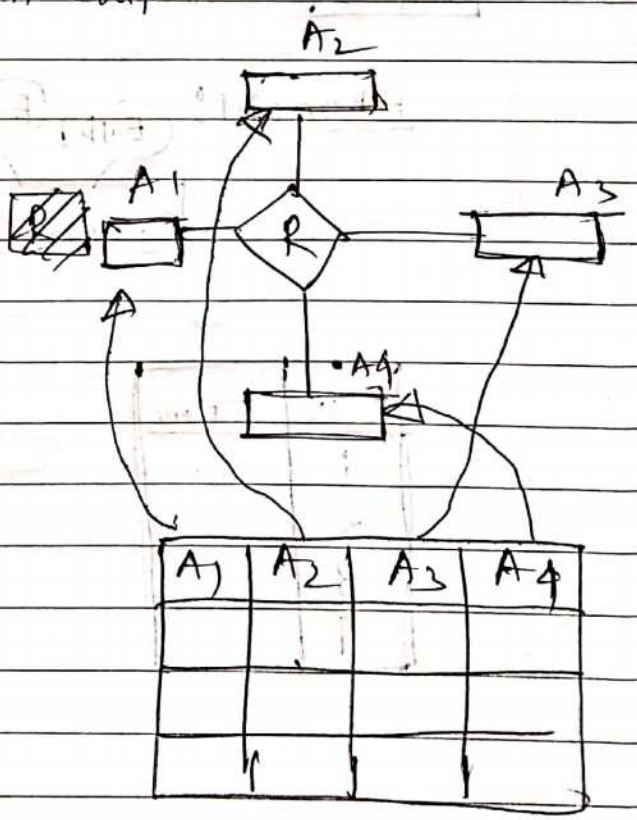
Relation model :

S.NO	FN	LN	~~P.NO~~
1			
2			
3			
4			
5			

S.NO	P.NO
1	P_1
1	P_2
1	P_3

Step-7 : "n-ary Relation-Chip"

ER model :



Relation chip :

A1	A2	A3	A4

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• Summary Of ER to Relation Data Base Conversion:

ER MODEL	Relational model
Entity type	"entity" relation
1:1 or 1:N relationship type	Foreign key (or relation)
M:N relationship type	relationship "relation" + 2 FKs
n-ary relationship type	relationship "relation" + n FKs
Simple attribute	Attribute
composite attribute	set of simple component attribute.
Multivalued attribute	Relation (table) and Foreign key.
value set	Domain
Key attribute	primary key

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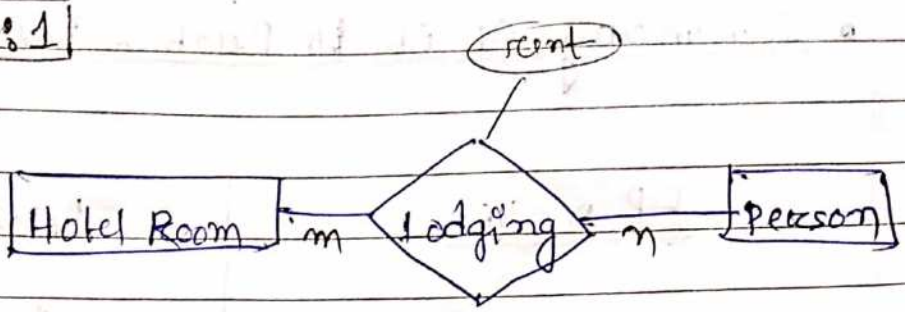
g-2005

Question : 1



lodging is a many to many relationship. Rent, payment to be made by person occupying different hotel rooms should be added as an attribute to -

a) hotel b) lodging c) person d) none.

→ If relationship is many to many we can't go any side.

g-2013

Question : 2

Given the basic ER and relational models, which of the following is incorrect?

a) An attribute of an entity can have more than one value.

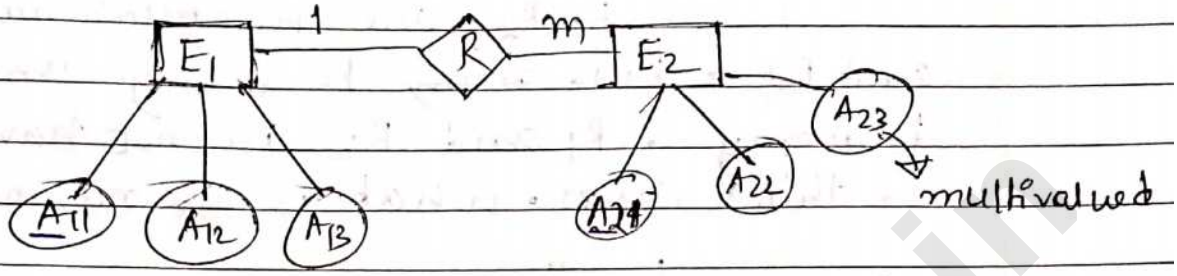
b) An attribute of an entity can be composite.

c) In a row of a relation table, an attribute can have more than one value.

d) In a row of a relational table, an attribute can be have exactly one value or a NULL value.

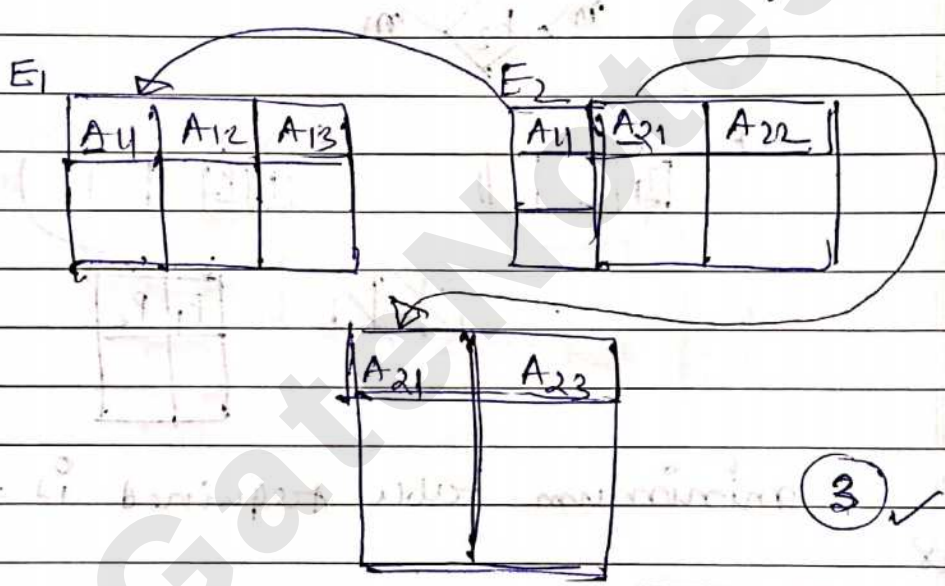
q- 2004

Question: 3



minimum number of table = ? (3)

→



(3) ✓

q- 2012

Question: 4

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	1

(a) (3,4) and (6,4)
(b) (5,2) and (7,2)
(c) (5,2) (7,2) and (9,5)
(d) (3,4) (4,3) and (6,4)

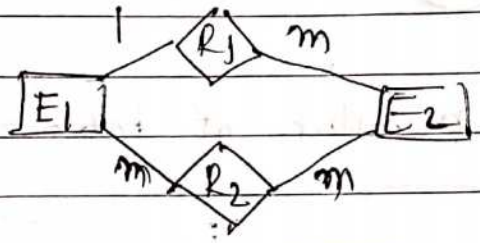
Q- 2005

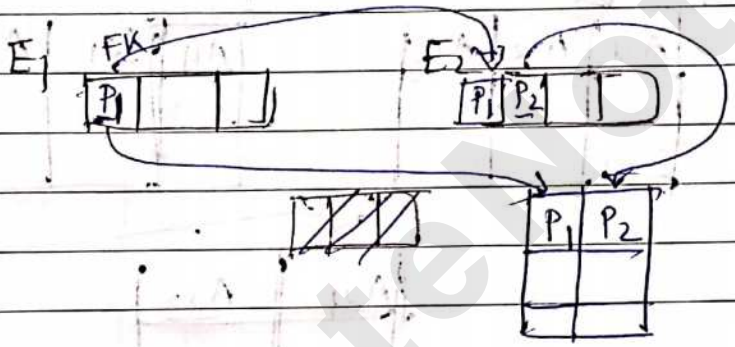
Question : 5

E_1, E_2 - two entities,

R_1, R_2 - are two relationship b/w E_1 and E_2. R_1 is one to many and R_2 is many to many. R_1 and R_2 does not have any attributes of their own. What is the number of tables?

→

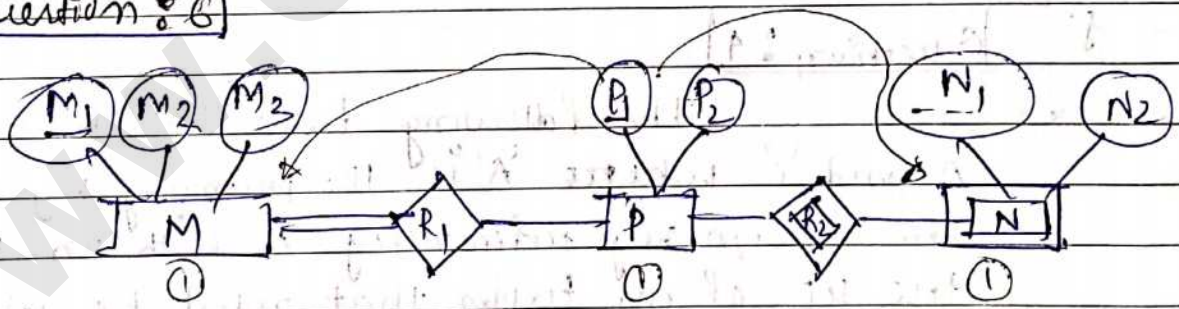




minimum table required is = (3)

Q- 2008

Question : 6



The minimum number of tables needed -

(A) 2 (B) 3 (C) 4 (D) 5.

Which of the following is a correct attribute set for one of the tables for the correct answer of the above question -

(A) $\{M_1, M_2, M_3, P_1\}$ (B) $\{M_1, P_1, N_1, N_2\}$ (C) $\{M, P, N\}$ (D) $\{M_1, P_1\}$

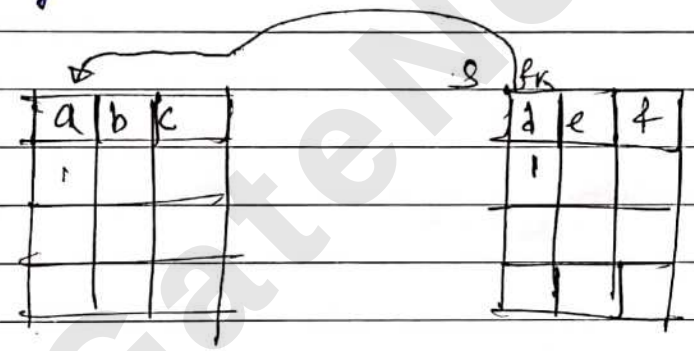
Question # 7

Let R(a, b, c) and S(d, e, f) be two relations 'd' is foreign key ~~fore~~ of S that refers to the primary key of 'R'. Consider the following four operations on 'R' and 'S'.

a) Insert into R. c) Delete from R
b) " " S d) " " S

Which of these can cause violation of referential integrity constraint - (b, c).

→



NORMALISATION

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- Introduction of Normalisation =

Emp.

EID	EN	DID
1	a	1

Dep

DID	DName	SID
1	CS	

EID	EN	DID	DN	SID			
1	a	1	CS	10			
2	b	1	CS	10			
3		1	CS	10			

anomalies (Problems)
- Insertion.
- Deletion.
- Update.

This are all the Problem which will occure If you try to reduce the overhead of deining the Data Base by combining all the table.

Solution =

Divide the table as small table as possible. To avoide anomalies the ideal size of table is two attribut.

Divide ~~the~~ table into small small table which will ~~control less~~ contain less number of attributes in such a way that deing not contain all this problem, In order to do that particulare process which is called as NORMALISATION.

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NORMALISATION (Cont'd)

→ Functional dependency (FD)
→ Candidate Key (CK)
} used to evaluate formaly.

• Introduction to FD :

	A	B	C
1			
2	a	b	
3			
4			

$A \rightarrow BC$
2 ab

if $t_1(A) = t_2(A)$
then
$t_1(BC) = t_2(BC)$

A	B	
a	1	
a	1	
b	2	
b	2	

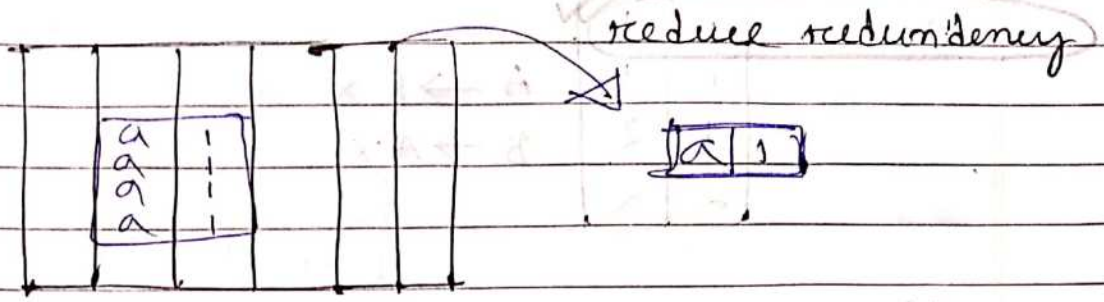
$A \rightarrow B$
1

A	B	C
a	1	d
a	1	e
a	1	f
a	1	g
b	2	h

(reduce redundency by making a new table)

new table.

A	B
a	1
b	2



1 Normal form (NF)
2 NF
3 NF
BCNF

to go 1NF → (we need FD. & CK) → BCNF

determine
(X) → (Y)

here, X & Y can be ~~set of~~ a collection of attribute or subset of attribute

• Classification of FD into 3 - Types -

(1) Trivial	(2) Non Trivial	(3) semi non-Trivial
A → A	X ∩ Y = ∅	~~X ∩ Y ≠ ∅~~
AB → A	A → B	AB → BC
X ⊇ Y	A → BC	X ∩ Y ≠ ∅
	AB → CD	

Examples (FD) =

Rule out the funtional dependencies based on the tables :

①

Eid	Ename
1	a
2	b
3	b

✓ Eid → Ename

✗ Ename → Eid → ruled out.

left hand side should unique.

(2)

A	B
1	1
1	2
2	2

$A \rightarrow B$ ✗
$B \rightarrow A$ ✗

(3)

✗ $A \rightarrow B$
✗ $B \rightarrow C$
✗ $B \rightarrow A$
✗ $C \rightarrow B$
✓ $C \rightarrow A$
✓ $A \rightarrow C$

A	B	C
1	1	4
1	2	4
2	1	3
2	2	3
2	4	3

(4)

✓ $A \rightarrow B$
✗ $B \rightarrow C$

A	B	C
1	1	1
1	1	0
2	3	2
2	3	2

(5)

✓ $XZ \rightarrow X$
✓ $XY \rightarrow Z$
✗ $XZ \rightarrow Y$
✓ $Y \rightarrow Z$
✗ $XXZ \rightarrow Y$

X	Y	Z
1	4	3
1	5	3
4	6	3
3	2	2

(6)

✓ $A \rightarrow B$
✗ $BC \rightarrow A$
✓ $B \rightarrow C$
✓ $AC \rightarrow B$

A	B	C
1	2	3
4	2	3
5	3	3

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9-2000

Question-1

Given the following relation instance -

X	Y	Z
1	4	2
1	5	3
1	6	3
3	2	2

Which of the following functional dependencies are satisfied by the instance -

× (a) $XY \rightarrow Z$ and $Z \rightarrow Y$

~~(b)~~ $YZ \rightarrow X$ and $Y \rightarrow Z$

× (c) $YZ \rightarrow X$ and $X \rightarrow Z$

× (d) $XZ \rightarrow Y$ and $Y \rightarrow X$

Question-2

From the following instance of relation schema R(A, B, C) We can conclude that:

A	B	C
1	1	1
1	1	0
2	3	2
2	3	2

× (a) A functionally determines B and B functionally determines C.

× (b) A functionally determines B and B does not functionally determine C.

(c) B does not functionally determine C.

x(a) A dependency does not functionally determine B and B does not functionally determine C.

* ~~Formal definition of FDs (functional dependencies)~~ :

• Various usages of FDs :

Operation which have perform on : FDs =

(I) identify additional FDs.
(II) identifying keys.
(III) identifying equivalence of FDs.
(IV) Finding minimal FD set.

TWO method (to perform this operations) =
(1) inference rules.
(2) closure set of attributes.

(1) Inference Rules :

(A) Reflexive : $A \rightarrow B$ if $B \subseteq A$.

(b) Transitive : $A \rightarrow B$ and $B \rightarrow C$ then $A \rightarrow C$.
(c) Decomposition : if $A \rightarrow BC$ then $A \rightarrow B$ and $A \rightarrow C$
(d) Augumentation : if $A \rightarrow B$ then $AC \rightarrow BC$.

(e) Union : if $A \rightarrow B$ and $A \rightarrow C$, then $A \rightarrow BC$.

(f) Composition rule : if $A \rightarrow B$ and $C \rightarrow D$, then $AC \rightarrow BD$.

(2) ~~Closure~~ Closure set of attributes:→

FDs: $A \rightarrow B$
$B \rightarrow D$
$C \rightarrow DE$
$CD \rightarrow AB$

$A^+ = \{B, D, A\}$
$B^+ = \{B, D\}$
$C^+ = \{D, E, C, A, B\}$
$(CD)^+ = \{C, D, E, A, B\}$
$(AD)^+ = \{B, A, D\}$.

g- 2006

Question - 1

Given,

~~FDs: A → B~~ FDs: $AB \rightarrow CD$
~~B →~~ $AF \rightarrow D$
$DE \rightarrow F$
$C \rightarrow G$
$F \rightarrow E$
$G \rightarrow A$

$(CF)^+ = ?$ $(AF)^+ = ?$
$(BG)^+ = ?$ $(AB)^+ = ?$

→ $(CF)^+ = \{C, F, G, E, A, D\}$

$(BG)^+ = \{B, G, A, C, D\}$

$(AF)^+ = \{A, F, D, E\}$

$(AB)^+ = \{A, B, C, D, G\}$

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Determining Candidate Keys =

→ with attribute (A B)
candidate key may possible – (A, B, AB)

→ attribute (ABC)
Candidate key – (A, B, C, AB, AC, BC, ABC)

→ attribute ($A_1, A_2, A_3, \cdots A_n$)
candidate key may possible – $(2^n - 1)$

R(ABCD)

FDS: $A \to B$
$B \to C$
$C \to D$
$D \to A$

$A^+ = \{A\ B\ C\ D\}$
$B^+ = (A\ B\ C\ D)$
$C^+ = (A\ B\ C\ D)$
$D^+ = (A\ B\ C\ D)$

① (ABCD)
④ (ABC)(ABD)(BCD)(ACD)
⑥ (AB)(AC)(AD)(BC)(BD)(CD)
④ (A)(B)(C)(D)

if A is candidate key then
(AB) (AC) (AD) (ABC) (ABD) (ACD)
(ABCD) will be Super key.

Here, for given ~~Example~~, FDs no. of candidate keys are '4'.

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Question – g – 1996

$R = (A, B, C, D, E, F)$

$FDs = (C \to F,\ E \to A,\ EC \to D,\ A \to B)$

Candidate Key = ?

(A) CD (B) EC (C) AE (D) AC

→ $(\ )^+ = (A\ B\ C\ D\ E\ F)$

$CE = (C, E, F, A, D, B)$ → Candidate Key.

no. of super key = 2^4

= 16 super keys possible which contain CE.

Question – g – 2014

$R = (E, F, G, H, I, J, K, L, M, N)$

and :

FDs : $\{$

$\{EF\} \to \{G\}$

$\{F\} \to \{I, J\}$

$\{EH\} \to \{K, L\}$

$\{K\} \to \{M\}$

$\{L\} \to \{N\}$ $\}$

What is Key for "R" ?

(a) $\{E, F\}$ (b) $\{E, F, H\}$ (c) $\{E, F, H, K, L\}$ (d) $\{E\}$.

→ $(EFH)^+ = \{E, F, G, H, I, J, K, L, M, N\}$

Date :

$(EFH)^+ = \{E, F, H, G, I, J, K, L, M, N\}$ ✓

$(EF)^+ = \{E, F, G, I, J\}$ ✗

E

and,

no of super key possible,

$2^7 = 2^5 * 2^2$

$= 32 * 4$

$= 128$ — SK possible that contain EFH.

Question -g- 2005

$R = (A, B, C, D, E, H)$

$FD = \{A \to B, BC \to D, E \to C, D \to A\}$

What are the candidate keys on R ?

✗ (a) AE, BE ✗ (b) AE, BE, DE.

✗ (c) AEH, BEH, BCH

✓ (d) (AEH, BEH, DEH)

→

$(\quad)^+ = (A, B, C, D, E, H)$

EH

$(EH)^+ = \{E, H, C\}$ ✗

SK-8 $(AEH)^+ = \{A, E, H, B, C, D\}$ ✓

SK-8 $(BEH)^+ = \{B, E, H, C, D, A\}$ ✓

$(CEH)^+ = \{C, E, H\}$ ✗

SK-8 $(DEH)^+ = \{D, E, H, A, B, C\}$ ✓

$SK = (k_1) + (k_2) + (k_3) - k_1k_2 - k_2k_3 - k_1k_3 + k_1k_2k_3$

Exclusive OR

Date :

Question — q - 2013

$R = (A\ B\ C\ D\ E\ F\ G\ H)$

$FDs = \{CH \to G$
$A \to BC$
$B \to CFH$
$E \to A$
$F \to EG\}$

How many candidate keys does the relation have?

→

$(D\_)^+ = \{A\ B\ C\ (D)\ E\ F\ G\ H\}$

So, here, 4 - ~~Got~~ candidate keys possible. (AD) (BD) (ED) (FD).

① $\times (D)^+ = \{D\}$

② ✓ $(AD)^+ = \{A, D, B, C, F, H, G, E\}$
✓ $(BD)^+ = \{B, D, C, F, H, E, G, A,\}$
× $(CD)^+ = \{C, D,\}$
✓ $(ED)^+ = \{E, D, A, B, C, F, H, G\}$
✓ $(FD)^+ = \{F, D, E, G, A, B, C, H\}$
× $(GD)^+ = \{G, D\}$
× $(HD)^+ = \{H, D\}$

③ (CD) (GD) (HD) — not add — (ABEF) — add — (CGH)

~~A C D~~
~~B C D~~
~~E C D~~
~~F C D~~

× $(GCD)^+ = \{G, C, D\}$
× $(HCD)^+ = \{H\ C\ D\ G\}$

× $(HGD)^+ = \{H, G, D\}$

~~H C D~~

④ × $(DCGH)^+ = \{D\ C\ G\ H\}$

Example - 1 - candidate Key.

① $R = (A\ B\ C\ D\ E)$

$FDs = \{AB \to C,\ C \to D,\ B \to E\}$

find candidate key.

→ $(AB)^+ = (A\ B\ C\ D\ E)$

↳ candidate key.. | Super key = $2^3 = 8$

② $R = (A\ B\ C\ D\ E)$

$FD = \{AB \to C,\ C \to D,\ B \to EA\}$

candidate key = ?

→ $(\ \downarrow\ )^+ = (A\ B\ C\ D\ E)$

B

① $(B)^+ = \{B, E, A, C, D\}$

B is the CK.

② $(AB)^+ = \{A\ B\ C\ D\ E\}$

$(CB)^+ = \{C\ B\ E\ A\ D\}$

$(DB)^+ = \{D\ B\ E\ A\ C\}$

$(EB)^+ = \{E\ B\ A\ C\ D\}$

no. of SK = $2^4 = 16$

③ $R = A\ B\ C\ D\ E\ F$

$FD = \{A \to B,\ C \to D,\ E \to F\}$

→ $(\ \downarrow\ )^+ = (A\ B\ C\ D\ E\ F)$

ACE

CK = ACE

no. of SK = $2^3 = 8$

$(ACE)^+ = \{A\ C\ E\ B\ D\ F\}$

④ $R = ABCD$

$FD = \{AB \to CD, D \to A\}$

$CK = ?$

→ $(\ )^+ = (ABCD)$

B

$\times (B)^+ = B$

$\checkmark (AB)^+ = (ABCD)$

$\times (CB)^+ = (CB)$

$\checkmark (DB)^+ = (DBAC)$

CB

SK_1 SK_2

$CK = ?$ (AB, DB)

$SK = 2^2$

$SK_1 + SK_2 - (SK_1 \cap SK_2)$

$= 2^2 + 2^2 - 2^1$

$= 8 - 2$

$= 6$

⑤ $R = (ABCD)$

$FD = \{AB \to CD, C \to A, D \to B\}$

→ $(\ )^+ = (ABCD)$

All → ②

attributes ①	②
$A^+ = (A)$	$\checkmark AB^+ = ABCD$
$B^+ = (B)$	$\times AC^+ = AC$
$C^+ = (AC)$	$\checkmark AD^+ = ADBC$
$D^+ = (DB)$	$\checkmark BC^+ = BCAD$
	$\times BD^+ = BD$
	$\checkmark CD^+ = CDAB$

CK

(AB)(AD)(BC)(CD)

With ③ - attributes -

(AC) (BD)

(ABCD)

4 - CK are possible (AB, AD, BC, CD)

Date :

⑥ $R = ABCDEF$

$FD = \{AB \to C, C \to D, D \to E, E \to F, F \to A\}$

$\Rightarrow$

$(\ )^+ = (ABCDEF)$

B

① * $(B)^+ = \{B\}$

② ✓$(AB)^+ = (ABCDEF)$

✓$(CB)^+ = (CBDEFA)$

✓$(DB)^+ = (DBEFAC)$

✓$(EB)^+ = (EBFACD)$

✓$(FB)^+ = (FBACDE)$

$CK = 5 . (AB, CB, DB, EB, FB)$

⑦

$R = ABCDEF$

$FD = \{AB \to C, C \to D, D \to EB, E \to F, F \to A\}$

$\Rightarrow$

$(\ )^+ = (ABCDEF)$

① $A^+ = A$

$B^+ = B$

✓$C^+ = (CDEBFA)$

✓$D^+ = (DEBFAC)$

$E^+ = (EFA)$

$F^+ = (FA)$

② ✓$(AB)^+ = (ABCDEF)$

$(AE)^+ = (AEF)$

$(AF)^+ = (AF)$

✓$(BE)^+ = (BEFACD)$

✓$(BF)^+ = (BFACDE)$

③ $(EAE)^+ = (AEBF)$

$CK = 5 \ (C, D, AB, BF, BE)$

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(8) R(ABCDEF)

FD = A → BCDEF ,
BC → ADEF .
DEF → ABC .

→ ( )$^+$ = (ABCDEF)

(1) ✓ A^+ = (ABCDEF)
× B^+ = (B)
× C^+ = (C)
× D^+ = (D)
× E^+ = (E)
× F^+ = (F)

(2) ✓ BC^+ = (BCADEF)
BD^+ = ×
BE^+ = ×
BF^+ = ×
CD^+ = ×
CE^+ = ×
CF^+ = ×
DE^+ = ×
DF^+ = ×
EF^+ = ×

(3) ✓ $(DEF)^+$ = (DEFABC)

CK = (A, BC, DEF)

(9) R = (ABCDE)
FD = { A → B, B → C, C → D, D → A }

→ ( )$^+$ = (ABCDE)
E

× E^+ = {E}

✓ AE^+ = (AEBCD)
✓ BE^+ = (BECDA)
✓ CE^+ = (CEDAB)
✓ DE^+ = (DEABC)

CK = 4

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(10)

$R = (A B C D E)$

FD: $A \to BC$

$CD \to E$

$B \to D$

$E \to A$

→

$( )^+ = (A B C D E)$

(1) ✓ $A^+ = (A B C D E)$

× $B^+ = (B D)$

× $C^+ = (C)$

× $D^+ = (D)$

✓ $E^+ = (E A B C D)$

(2)

✓ $(BC)^+ = (B C D E A)$

$(BD)^+ = (B D)$

✓ $(CD)^+ = (C D A E B)$

(3) ~~$(BD =$~~

CK = (A, E, BC, CD)

Example - Candidate Key for Sub relation -

(1) $R(ABCD)$

$\{AB \to CD, D \to A\}$

What are the Candidate Keys of Sub relation

$R_1(BCD)$

→ $B^+ = B$

$C^+ = C$

$D^+ = DA$

this table is not going to have any CK with one attribute.

$BC^+ = BC$

$CD^+ = CDA$

✓ $BD^+ = BDAC$

here candidate key = BD.

(2) R(ABCDEF)

{ $AB \to C$, $B \to D$, $AD \to F$, $C \to D$, $D \to E$, $E \to F$, $E \to D$ }

Find candidate keys for $R_1(DEF)$.

→ ✓ $D^+ = DEF$

✓ $E^+ = EDF$

✗ $F^+ = F$

For this table CK = D and E.

(3) R(ABCDE)

{ $A \to BC$, $CD \to E$, $B \to D$, $E \to A$ }

What are the CK of $R_1(ABCE)$

⇒ ✓ $A^+ = BCDEA$

✗ $B^+ = BD$

✗ $C^+ = C$

✓ $E^+ = DEABC$

✓ $BC^+ = BCDEA$

✗ $BD^+ = BD$

✓ $CD^+ = CDEAB$

✓ $BC^+ = BCDEA$

for relation $R_1(ABCE)$ CK = (A, E, BC)

Example: Checking additional FDs —

(1)

R(AB)

X	Y
∅	∅
A	A
B	B
AB	AB

$\emptyset \to \emptyset$

total possible FDs = 16

3+1+1

~~$\emptyset \to \emptyset$~~	$A \to \emptyset$	$B \to \emptyset$	$AB \to \emptyset$
$\emptyset \to A$	$A \to A$	$B \to A$	$AB \to A$
$\emptyset \to B$	$A \to B$	$B \to B$	$AB \to B$
$\emptyset \to AB$	$A \to AB$	$B \to AB$	$AB \to AB$

(i)

$A \to B$
$B \to A$

13-FDs are implied by

(ii)

$A \to B$

11- FDs are implied by

(11- FDs valid according to FDs)

↳ 10 additional we can derive from $A \to B$!

Ex-2

R(ABC)

FDS: $\{A \to B, B \to C\}$

What are all ~~Fs~~ additional FDs that can derive from given FDs.

→

$X \to Y$

$2^3 \quad 2^3$

$8 \times 8 = 64$

$\emptyset \to \emptyset$ - ①

$A \to \{ABC\} - 2^3 = 8$

$B \to \{BC\} - 2^2 = 4$

$C \to \{C\} - 2^1 = 2$

$AB \to \{ABC\} - 2^3 = 8$

$BC \to \{BC\} - 2^2 = 4$

$AC \to \{ABC\} - 2^3 = 8$

$ABC \to \{ABC\} - 2^3 = 8$

$A^+ = ABC$

$A \to \emptyset$

$\to A$

$\to B$

$\to C$

$\to AB$

$\to BC$

$\to CA$

$C^+ = C$

$\to \emptyset$

$B^+ = BC$

$\to \emptyset$

$\to B$

$\to C$

$\to BC$

43 - Functional Dependencies possible with given FDs.

R($A_1, A_2, A_3 \ldots A_n$)

$X \to Y$

$2^n \quad 2^n$

$2^n \times 2^n = 2^{2n}$ - total FDs possible with 'n' attributes

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Question - g - 2005

In a schema with attributes A, B, C, D and E ; following set of FD's are given
$A \to B$; $A \to C$, $CD \to E$, $B \to D$, $E \to A$.
Which of the following FDs is Not Implied by the above set ?

(a) $CD \to AC$ (b) $BD \to CD$
(c) $BC \to CD$ (d) $AC \to BC$

→ $CD^+ = CDEA$ $AC^+ = ACBD$

$BC^+ = BCDEA$ $BD^+ = BD$

Equivalence of FDs :

(1)

F: { $A \to C$, $AC \to D$, $E \to AD$, $E \to H$ }
G: { $A \to CD$, $E \to AH$ }

→ * → $F \geq G$ ✓.
→ $G \geq F$ ✓

$F \cong G$

$A^+ = ACD$ | $A^+ \to ACD$
$E^+ = EADH$ | $E \to EAHCD$

So, both the FDs are equivalent.

$F \cong G$