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ER Diagram to Relational Model Conversion

Complete Course on Database Management System

Vishvadeep Gothi • Lesson 14 • July 5, 2023

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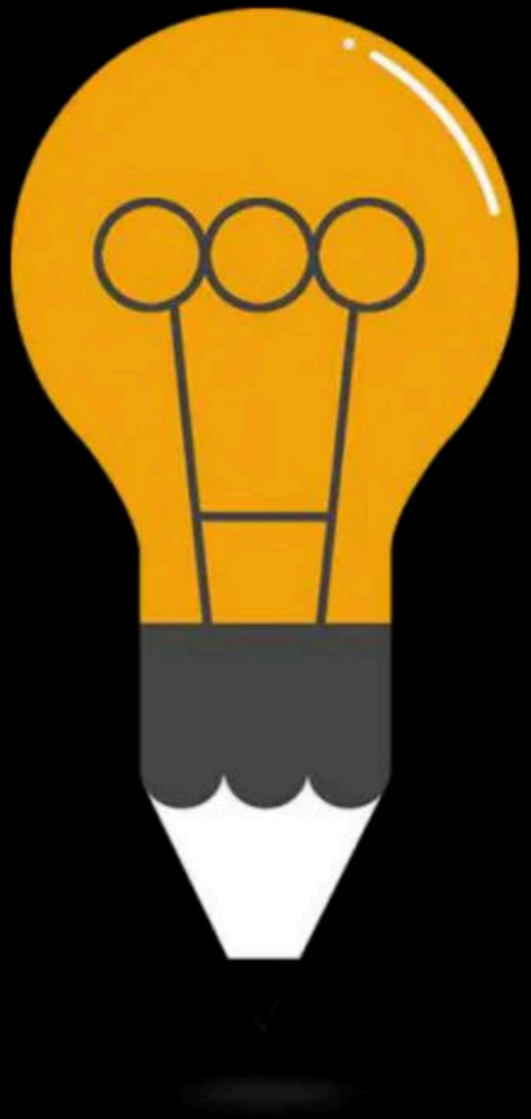

DBMS

Relational DB

By: Vishvadeep Gothi

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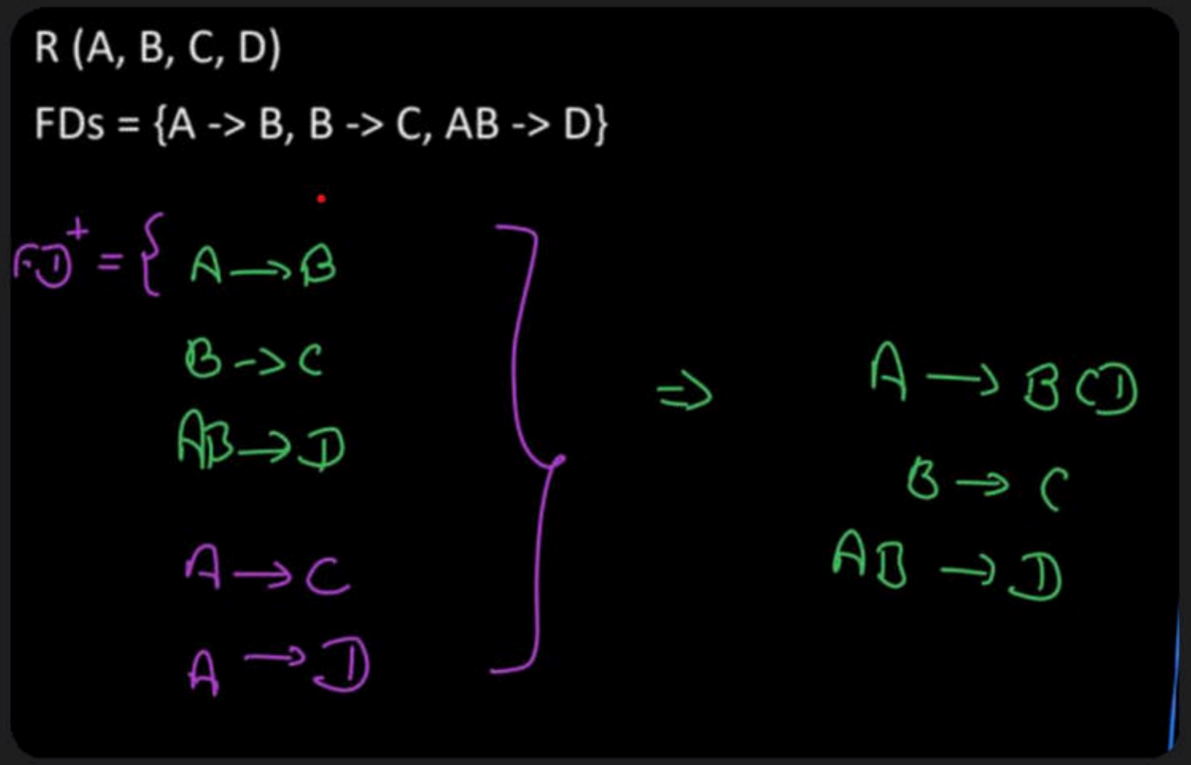
▲ 2 • Asked by Gaurav

sir yaha pr a->bcd kaise possible hai



$A \rightarrow B$

$A \rightarrow C$

$A \rightarrow BC$

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Functional Dependency

Consider a relation R and 2 attributes A and B in R.

B is functionally dependent on A (denoted by A → B), if each value of A is associated with exactly one value in B in relation R.

A	B	C	D
a_1	b_1	c_1	d_1
a_1	b_2	c_1	d_2
a_2	b_2	c_2	d_2
a_2	b_2	c_2	d_3
a_3	b_3	c_2	d_4

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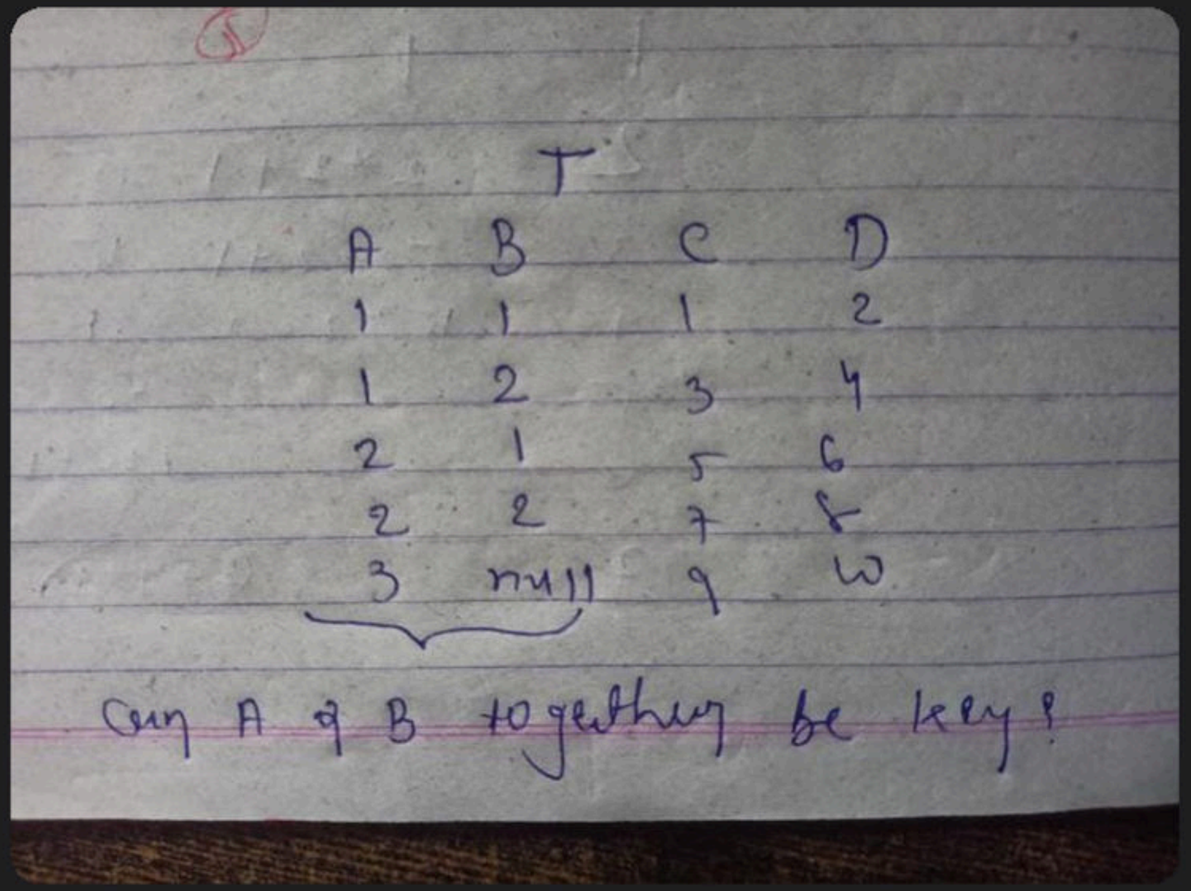
▲ 1 • Asked by Raj

Can A and B together can be CK?



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Functional Dependency: Example

A	B	C
10	B1	1
10	B2	2
11	B4	1
12	B3	4
13	B1	1
14	B3	4

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Question

Consider a relation R (A, B, C, D, E, F, G)

FDs = {

AB → D,

G → A,

D → F,

B → E,

E → C,

A → G,

C → B,

}

$AB^+ = \{A, B, D, F, G, E, C\}$

GB

GC

AC

AE

GE

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Question

Consider a relation R (A, B, C, D, E, G)

FDs = {

AD → E,

AB → C,

B → D,

AC → B,

E → G,

BC → A

}

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

$AC^+ =$

$BC^+ =$

Prime attributes $= \{A, B, C\}$

non-prime $-$ " $= \{D, E, G\}$

key = AB, AC, BC

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Question

Consider a relation R (A, B, C, D, E, G)

FDs = {

A → B,

BC → D,

E → C,

D → A

}

$AEG^+ = \{A, E, G, C, B, D\}$

$DEG^+ = \{D, E, G, A, B, C\}$

$BEG^+ = \{B, E, G, C, D, A\}$

Question

Consider a relation R (A, B, C, D, F, G, E)

FDs = {

BCD → A,

BC → E,

A → F,

F → G,

C → D,

A → G

}

BC → A

BC → AE

A → F

F → G

C → D

Find the minimal set?

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Normalization

Normalization is the process of minimizing redundancy from a relation or set of relations

Redundancy in relation may cause insertion, deletion, and update anomalies

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Example

C_Id	C_name	P_Id	P_Name	P_Price
C1	Chatur	P1	Shirt	1500
C2	Suhas	P1	Shirt	1500
C3	Rencho	P2	Jeans	2200
C4	Piya	P4	Trouser	1900
C5	Piya	P3	Tshirt	1300
C6	Suhas	P4	Trouser	1900
C7	Viru	P1	Shirt	1500
C8	Raju	P3	Tshirt	1300
C9	Viru	P1	Shirt	1500
C10	mm	NULL	NULL	NULL

Insertn new customers

Pid, Pname, P_price should not be NULL

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Insert Anomalies

C_Id	C_name	P_Id	P_Name	P_Price
C1	Chatur	P1	Shirt	1500
C2	Suhas	P1	Shirt	1500
C3	Rencho	P2	Jeans	2200
C4	Piya	P4	Trouser	1900
C5	Piya	P3	Tshirt	1300
C6	Suhas	P4	Trouser	1900
C7	Viru	P1	Shirt	1500
C8	Raju	P3	Tshirt	1300
C9	Viru	P1	Shirt	1500

Update Anomalies

C_Id	C_name	P_Id	P_Name	P_Price
C1	Chatur	P1	Shirt	1500
C2	Suhas	P1	Shirt	1500
C3	Rencho	P2	Jeans	~~2200~~ 2500
C4	Piya	P4	Trouser	1900
C5	Farhan	P3	Tshirt	1300
C6	Suhas	P4	Trouser	1900
C7	Viru	P1	Shirt	1500
C8	Raju	P3	Tshirt	1300
C9	Viru	P1	Shirt	1500

assuming product jeans price has been changed to 2500

Rencho purchased jeans in 2200 but now my db shows in 2500

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Delete Anomalies

C_Id	C_name	P_Id	P_Name	P_Price
C1	Chatur	P1	Shirt	1500
C2	Suhas	P1	Shirt	1500
~~C3~~	~~Rencho~~	~~P2~~	~~Jeans~~	~~2200~~
C4	Piya	P4	Trouser	1900
C5	Piya	P3	Tshirt	1300
C6	Suhas	P4	Trouser	1900
C7	Viru	P1	Shirt	1500
C8	Raju	P3	Tshirt	1300
C9	Viru	P1	Shirt	1500

Delete product jeans

⇓

customer with id C3 also deleted

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Normalization

It is a process of grouping attributes into well structured relations, that contain minimum redundancy

It focuses on characteristics of specific entities

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Normalization

One relation should have one theme

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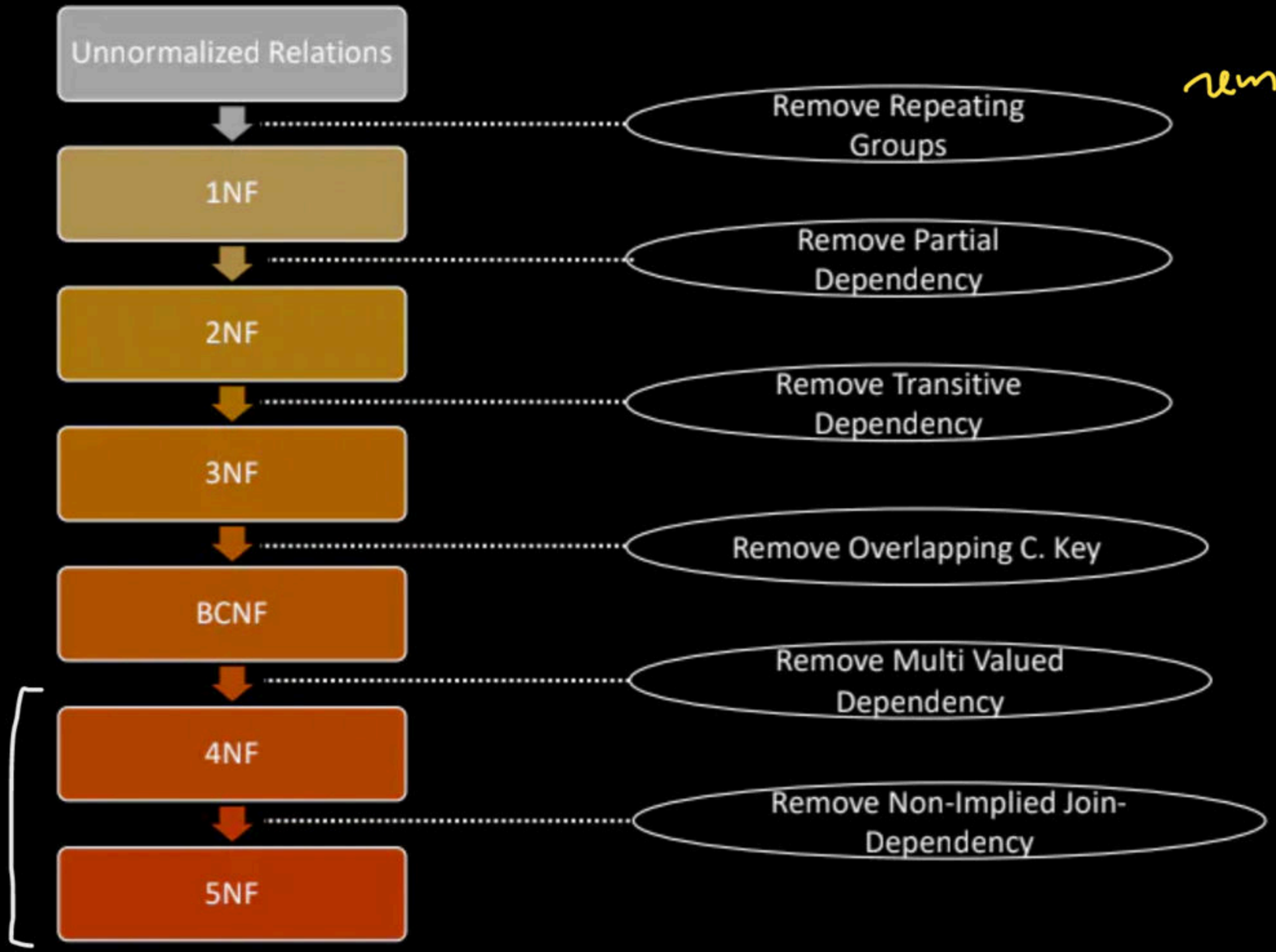
Normalization



remove multivalued attributes

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1NF

A relation R is said to be in 1NF if there is no any multivalued attribute in R

Student

Rno	name	dob	Phno
1	Amit	1Jan	1234, 4567
2	Priya	4July	4545, 6767
3	Sumit	27 oct	7899312226

Phno is multivalued attribute,

⇓

eliminate multivalued attribute

⇓

1. Increase rows
2. —"— columns
3. Decompose relation

1 Increase rows :-

Student

Rno	name	dob	phno
1	Amit	1 Jan	1234
1	Amit	1 Jan	4567
2	Riya	4 July	4545
2	Riya	4 July	6767
3	Sumit	27 oct	7895312226

Problems :-

1. Rno is no longer a primary key
2. Too much of redundent info

2) Increase columns :-

student

Rno	name	dob	phno1	phno2
1	Anil	1 Jan	1234	4567
2	Riya	4 July	4545	6767
3	Sunil	27 oct	7899312226	NULL

Problem :-

→ wastage of space if multiple NULL values in phno2.

→ wastage may increase if one row has > 2 phone nos.

③ Decompose Relation :-

keep multivalued attribute along with p.k. of table in another table.

Student

Rno	name	dob
1	Amit	13th
2	Rinya	4th July
3	Sumit	27 oct

Student_Contact

FK Rno	phno
1	1234
1	4567
2	4545
2	6767
3	7899312226

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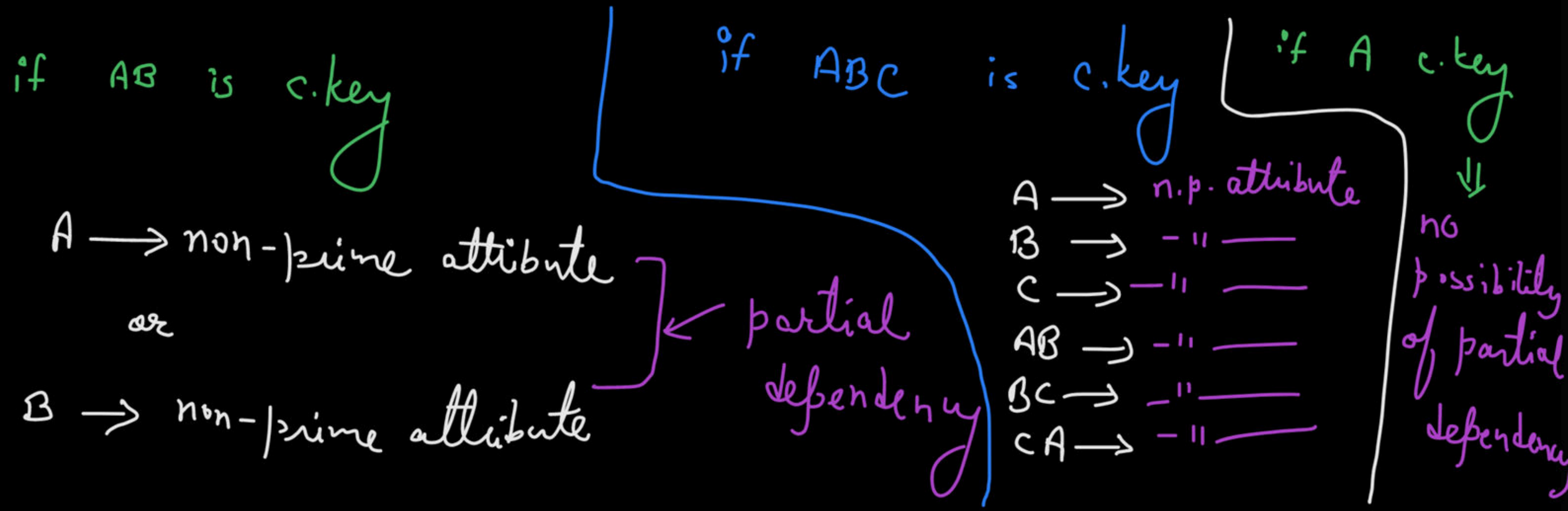
2NF

A relation R is said to be in 2NF if it is already in 1NF and there is no any non-prime attribute in R which is partially dependent on prime attribute of R



if data of table not given

table is in 1NF already

Ex:-

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

$FD^S = \{ AB \rightarrow CD$

$B \rightarrow D \}$

C.

key $\Rightarrow$ AB

Prime $\Rightarrow$ A, B

non-prime $\Rightarrow$ C, D

Partial dependency

$\Downarrow$

$B \rightarrow D$

$\Downarrow$

Given relation R is not in 2NF

$\Downarrow$

Sol^n :- To bring R in 2NF, decompose R into 2 relations such that, remove partially dependent attribute from R and keep it in another relation. → dependents with attribute on which it is

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$R1(A, B, C)$

$R2(B, D)$

FD $\Rightarrow$ $AB \rightarrow C$

FD $\Rightarrow$ $B \rightarrow D$

key $\Rightarrow$ AB

key $\Rightarrow$ B

$\Rightarrow$ both R1 and R2 are in 2NF

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

$FD = \{ AB \rightarrow C,$
$A \rightarrow D,$
$B \rightarrow E \}$

c.

key $\Rightarrow$ AB

Prime $\Rightarrow$ A, B

non-prime $\Rightarrow$ C, D, E

2 partial dependency

$A \rightarrow D$

$B \rightarrow E$

$R(A, B, C)$ $\quad$ $R1(A, D)$ $\quad$ $R2(B, E)$

$AB \rightarrow C$ $\quad$ $A \rightarrow D$ $\quad$ $B \rightarrow E$

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2NF

Consider a relation R (A, B, C, D) with candidate key AB. Select the FD which will make the relation not in 2NF?

1) AB → C
2) AB → D
3) A → D
4) B → C

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Question

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

FDs = {

AB → C,

D → E

}

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3NF

A relation R is said to be in 3NF if there it is already in 2NF and there is no any non-prime attribute in R which is transitively dependent on the key of R

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Question

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

FDs = {

A → BCF,

C → DE

}

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Question

Consider a relation R (A, B, C, D) with candidate key AB. Select the FD which will make the relation not in 3NF?

AB → C

AB → D

C → D

D → C

}

BCNF (Boyce Codd Normal Form)

A relation R is said to be in BCNF if there it is already in 3NF and for every functional dependency $\alpha \rightarrow \beta$, α should be super key in R

BCNF (Boyce Codd Normal Form)

R (A, B, C, D)

FDs = {

AB → CD,

D → B

}

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Question

Consider a relation R with attributes A, B, C, D, E, X and Y; and following FDs:

AB → C,

AC → B,

AD → E.

B → D,

BC → A,

E → X

Which of the following is the highest possible normal form satisfied by the relation R?

(A) 1NF (B) 2NF

(C) 3NF (D) BCNF

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Questions on Normalization

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Lossy vs Lossless Decomposition

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Question GATE-1995

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 $3NF$ but not in BCNF.
B. Determine the minimal keys of relation R.

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Question GATE-1997

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

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

This relation is

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

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Question GATE-1998

Which normal form is considered adequate for normal relational database design?

A. $2NF$ B. $5NF$ C. $4NF$ D. $3NF$

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Lossy Join Decomposition

The decomposition of relation R into R1, R2, R3 ….. Rn is lossy when the join of R1, R2, R3 ….. Rn does not produce the same relation as in R.

Lossy Join Decomposition

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12	Vishvadeep	CSE
56	Vishvadeep	AI

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Student_details

Rollno	Sname
12	Vishvadeep
56	Vishvadeep

S_Department

Sname	Dept
Vishvadeep	CSE
Vishvadeep	AI

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Lossless Join Decomposition

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56	Vishvadeep

S_Department

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Lossy Join Decomposition

Assuming decomposition of relation R into R1, R2, R3 ….. Rn. Then

$R = R1 \bowtie R2 \bowtie R3 .... \bowtie Rn$ Lossless

$R \subset R1 \bowtie R2 \bowtie R3 .... \bowtie Rn$ Lossy

Dependency Preserving Decomposition

A Decomposition D = { R1, R2, R3….Rn } of R is dependency preserving with respect to a set F of Functional dependency if

(F1 U F2 U … U Fn)+ = F+

Dependency Preserving Decomposition

Example 1:

R (A, B, C, D)

FDs = {

AB → C,

B → D

}

Decomposition:

R1 (A, B, C) FD = {AB → C}

R2 (B, D) FD = {B → D}

Dependency Preserving Decomposition

Example 1:

R (A, B, C, D)

FDs = {

AB –> C,

C –> D,

D –> A}

Decomposition

R1 (A, B, C) FD = {AB → C}

R2 (C, D) FD = {C → D}

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Question GATE-2001

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

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

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Happy Learning.!