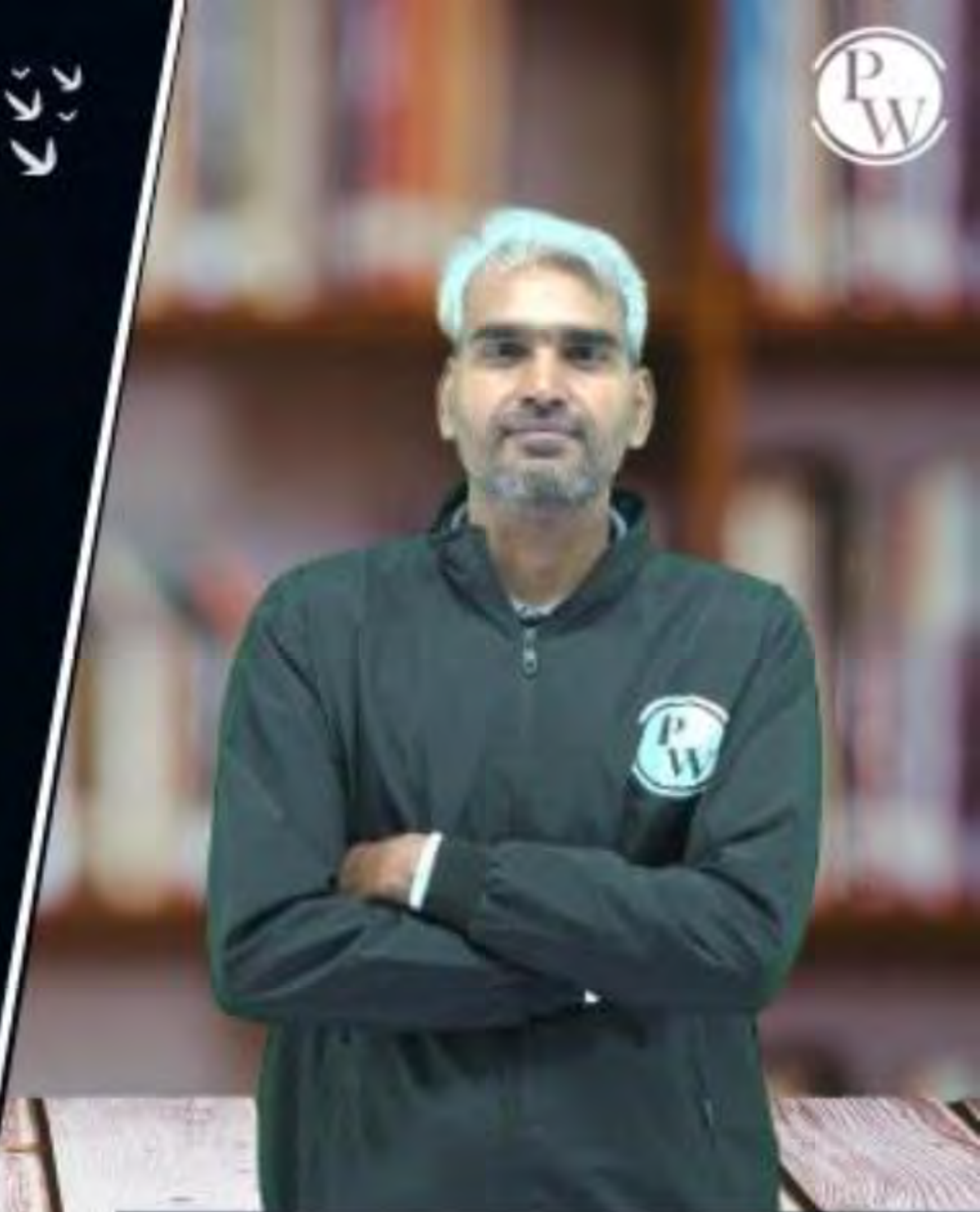
GATE

DS & AI

Database Management System

Super 1500+

Lecture No. 03



By- Vishal Sir

Recap of Previous Lecture

- **Topic** Relationship between FD sets
- **Topic** Minimal cover
- **Topic** FD set of a sub-relation of given relation

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Topics to be Covered

- **Topic** Normal forms
- **Topic** Lossless join decomposition
- **Topic** Dependency preserving decomposition
- **Topic** Decomposition up to BCNF

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#Q.13 Consider the relation schema R(A, B, C, D, E, F) with Fd's

CK = (AB), (EB), (BC)

{$\underbrace{AB}_{S.K} \rightarrow CD$ BCNF, Ps.ck / Ps.c.k $E \rightarrow A$ {3NF}

$\underbrace{BC}_{S.K} \rightarrow EF$ BCNF, $\underbrace{BE}_{S.K} \rightarrow F$ } BCNF

Highest normal satisfied by the relation R is

A 1 NF

B 2 NF

C 3 NF

D BCNF

None of them are allowed in BCNF

For BCNF in $X \rightarrow Y$, X Must be S.K

Case ① P.S.C.K ⟶ N.P.A. {Allowed in 1NF but not allowed in 2NF}

Case ② N.P.A ⟶ N.P.A.

Case ③ (P.S.C.K + N.P.A) ⟶ N.P.A.

{Allowed in 1NF & 2NF but not allowed in 3NF}

Case ④ P.S. of one C.K ⟶ P.S. of another C.K

Case ⑤ (P.S. of one C.K + N.P.A) ⟶ P.S. of another C.K

{Allowed in 1NF, 2NF, 3NF, but Not allowed in BCNF}

#Q.14 Consider a relation schema R (V , W , X , Y) with the following functional dependencies-

$$F = \{V \to W, \quad W \to X,$$
$$X \to Y, \quad Y \to W\}$$

If relation R is decomposed into three sub-relations R1 (V , W) , R2 (W , X) and R3 (W , Y), then which of the following is true?

R (V W X Y)

$R_1(V, W)$ $F_1 \{V \to W\}$ CK = V

$R_2(W, X)$ $F_2 = \{W \to X, X \to W\}$ C.K = W, X

$R_3(W, Y)$ $F_3 = \{W \to Y, Y \to W\}$ C.K: W, Y

$R_1 \bowtie R_2 (V, W, X)$

$(R_1 \bowtie R_2) \bowtie R_3$ is lossless

A. Decomposition is lossless join decomposition as well as dependency preserving.

B. Decomposition is lossy join decomposition, but dependency preserving.

C. Decomposition is lossless join decomposition, but not dependency preserving.

D. Decomposition is lossy join decomposition, and not dependency preserving.

#Q.15 Consider a relation schema X(P,Q,R,S,T) with the following functional dependencies-

$$F = \{P \rightarrow Q\,R,\ QR \rightarrow S\,T,\ Q \rightarrow R\}$$

While trying to decompose the relation into BCNF.

A. Decomposition can be lossless join decomposition as well as dependency preserving.

B. Decomposition can not be lossless join decomposition, but dependency preserving.

C. Decomposition can be lossless join decomposition, but can not be dependency preserving.

D. None of the above statements is correct.

$X(PQRST)$ $\{P \to QR,\ QR \to ST,\ Q \to R\}$

$P \to QR$: BCNF; $QR \to ST$: 2NF; $Q \to R$: 2NF

C.K: (P)

$Q \to R$

$(QR)^+ = \{QRST\}$

$R_1(QRST)$

$\{Q \to RST$ (BCNF)

$QR \to ST\}$ (BCNF)

C.K: Q

$R_2(PQ)$

$\{P \to Q\}$ (BCNF)

C.K: P

Lossless

+

Dep. preserving

+

BCNF

#Q.15 Consider a relation schema X(P,Q,R,S,T) with the following functional dependencies-

$$F = \{P \rightarrow Q\,R,\ QR \rightarrow S\,T,\ Q \rightarrow R\}$$

[redacted]

+ While decomposing the relation into BCNF, What are the minimum number of sub-relations created ?

[redacted]

$\boxed{\text{Ans} = 2}$

[redacted]

#Q.16 Consider a relation schema X(P,Q,R,S,T) with the following functional dependencies-

$$F = \{ P \rightarrow Q, Q \rightarrow R, QS \rightarrow T \}$$

While trying to decompose the relation into BCNF.

A. Decomposition can be lossless join decomposition as well as dependency preserving.

B. Decomposition can not be lossless join decomposition, but dependency preserving.

C. Decomposition can be lossless join decomposition, but can not be dependency preserving.

D. None of the above statements is correct.

$X(PQRST)$

$P \to Q$ 1NF
$Q \to R$ 2NF
$QS \to T$ 2NF

$P \to Q$
$(PQ)^+ = \{P, Q, R\}$

$R_1(P, Q, R)$

$F_1 = \{ P \to Q$ (BCNF), $Q \to R$ (2NF) $\}$

C.K = P

$R_{new}(QST)$

$F_{new} = \{QS \to T\}$ BCNF

C.K = QS

C.K = (PS)

$R_2(PST)$

$F_2 = \{\underbrace{PS}_{S.K} \to T\}$ BCNF

C.K = PS

$(QS)^+$ w.r.t $F_1 \cup F_2 = \{Q, S, R\}$

$T \notin (QS)^+$

$\therefore QS \to T$ is lost

lossless + 2NF + Not dep. Preserving

Final decomposition

$R_3(QR)$
$Q \to R$ BCNF
CK = Q

$R_4(PQ)$
$P \to Q$ {BCNF}
CK = P

$R_{new}(QST)$
$QS \to T$ (BCNF)
CK = QS

$R_2(PST)$
$PS \to T$ (BCNF)
CK : PS

Lossless + Dep. Preserving + BCNF

#Q.17 Let R(A,B,C,D) is a relational schema with

FDs: {AD→B, A→C, B→D }

Suppose R is decomposed into two sub-relations R1(A,C) and R2(B,A,D)

Which of the following is/are false?

BCNF 3NF

Dep. Preserving

Lossless

R(ABCD)

R_1(AC)

A → C (BCNF)

CK: A

Common Attribute is a key

R_2(BAD)

AD → B (BCNF)

Pscle B → D Pscle (3NF)

C.K: AD, AB

A. Both R1 and R2 are in BCNF.

B. Decomposition is lossless join decomposition as well as dependency preserving. (True)

C. Decomposition is not lossless join decomposition, but dependency preserving.

D. Decomposition is lossless join decomposition but not dependency preserving.

R ⋈ S

#Q.18 Let R(A, B, C) is a relation with 30 tuples, and A is primary key of relation R. S(A,D,E) is another relation with 50 tuples, A and D together form primary key of relation S and in relation S attribute 'A' is the foreign key and it references attribute 'A' of relation R.

Let X is the minimum number of tuples in R⋈S, and Y is the maximum number of tuples in R⋈S.

50

50

Value of |X+Y| is 100 Ans

EMP

Eid	- - -	Supervisor
E1		E5
E2		E5
E3		E4
E4		E1
E5		NULL

Student

Sid	
S1	
S2	
S3	
S4	

Enroll

Sid	Cid	fee
S1	C1	
S1	C2	
S2	C1	
S2	C3	
~~S5~~		

Course

Cid	
C1	
C2	
C3	
C4	

All values of A are unique

Need not be unique and can not take NULL value

$R(\underline{A}\ B\ C) \bowtie S(\underline{A}\ D\ E) \Rightarrow$ # tuples = ?

R.A	S.A
1	1
2	1
3	1
4	2
⋮	2
	3
	3
	3
	4
	4
	4
	⋮

$$\boxed{\text{Values of A in Rel}^n\ S \subseteq \text{Values of A in Rel}^n\ R}$$

In $R \bowtie S$, each tuple of S will relate with exactly one tuple of R

$\therefore$ total no. of tuples in $R \bowtie S$ will be same as No. of tuples in 'S'

* Let R(A B C) & S(A D E) are arbitrary relation and number of tuples in R = m & number of tuples in S = n

And X = Min no. of tuples in $R \bowtie S$

& Y = Max No. of tuples in $R \bowtie S$

then $\boxed{X = 0 \qquad Y = (m * n)}$

R	A	B	C
	1	2	3
	2	2	4
	3	5	6

S	A	D	E
	4	9	6
	5	3	8
	6	5	8

Max = $(m * n)$

Min = 0

2 mins Summary

Topic Normal forms

Topic Lossless join decomposition

Topic Dependency preserving decomposition

Topic Decomposition up to BCNF

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THANK - YOU

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