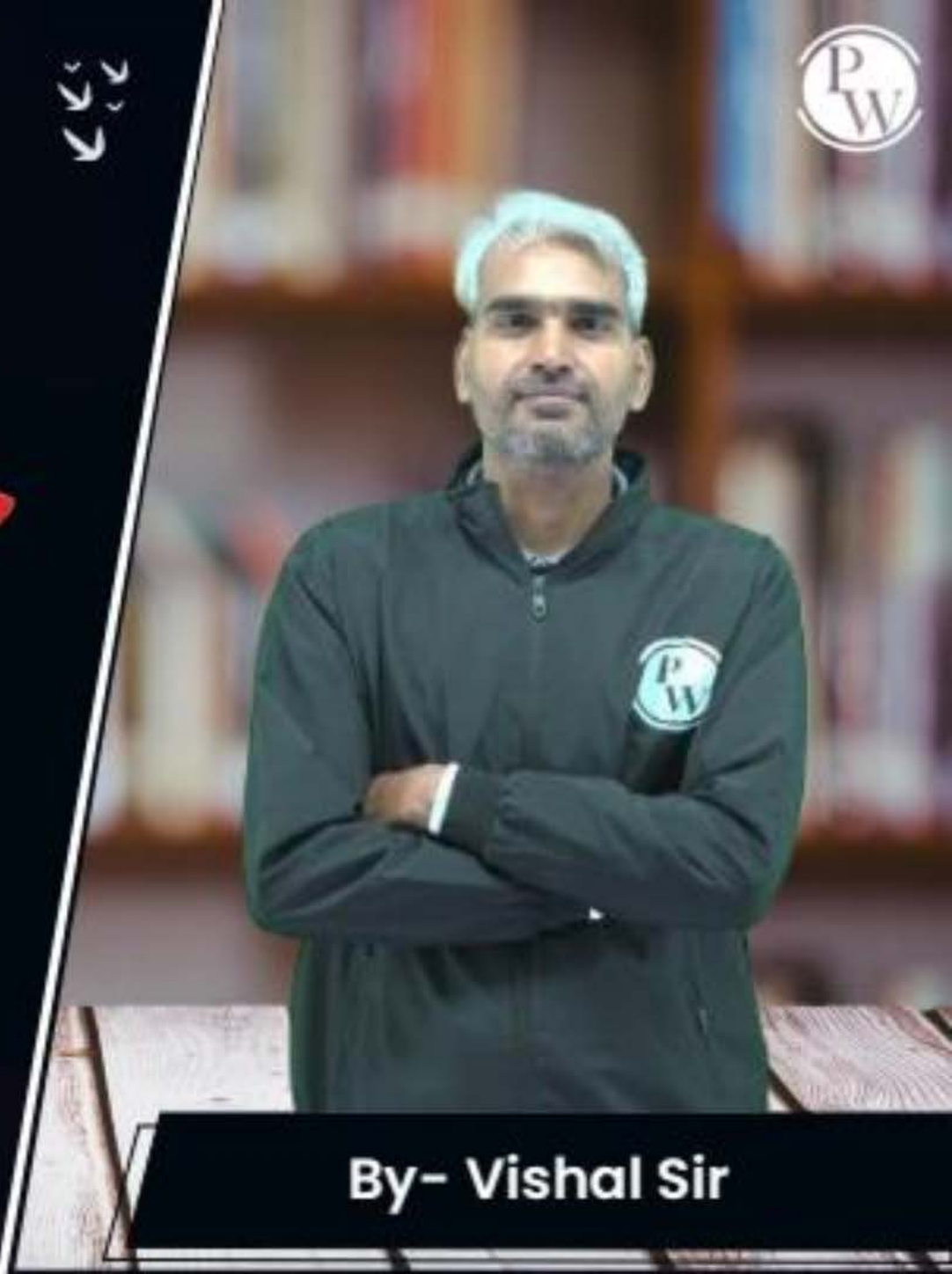
GATE

# DS & AI

## Database Management System

Super 1500+

Lecture No. 02



By- Vishal Sir

# Recap of Previous Lecture

Topic Functional dependencies

Topic Closure of a set of attributes

Topic Number of Candidate keys and Super keys

Slide

# Topics to be Covered

- Topic — Relationship between FD sets
- Topic — Minimal cover
- Topic — FD set of a sub-relation of given relation
- Topic — Normal forms

Slide

if MCQ question then most appropriate Ans is 'C'

if MSQ then both (C) & (D) are Correct

#Q.7 Suppose, a relational schema R (P,Q, R, S) and set of functional dependencies F and G are as follow:

$f_1 = F : \{ P \rightarrow Q, Q \rightarrow R, R \rightarrow S \}$

$f_2 = G : \{ P \rightarrow QR, R \rightarrow S \}$

$Q^+ \text{ w.r.t } G = \{Q\}$

- A F1 = F2
- B F1 ⊆ F2
- C F2 ⊆ F1
- D F1 ≠ F2
- (E) $F_2 \subset F_1$

$F_1 \subseteq F_2$ if $f_2$ Covers $f_1$.

i.e. all FD.of $F_1$ can be inferred by $F_2$

$F_1 \nsubseteq F_2$

& $F_2 \subseteq F_1$

if $F \subseteq G$ & $G \subseteq F$ then $F = G$

if $F \subseteq G$ but $G \nsubseteq F$ then $F \subset G$ & $F \neq G$

if $G \subseteq F$ but $F \nsubseteq G$ then $G \subset F$ and $F \neq G$

#Q.8 Suppose, a relational schema R (v w x y z) and set of functional dependencies F and G are as follow:

$F_1$: { $w \rightarrow x$, $wx \rightarrow y$, $z \rightarrow wy$, $z \rightarrow v$ }

$F_2$: { $w \rightarrow xy$, $z \rightarrow wx$ }

$F_1 \subseteq F_2$ or not ✗ (No)

$F_2 \subseteq F_1$ or not

A F1 = F2

B F1 ⊆ F2

C F2 ⊆ F1

D F1 ≠F2

#Q.9 Find the canonical cover of $F = \{ A \rightarrow BC, B \rightarrow CE, A \rightarrow E, AC \rightarrow H, D \rightarrow B\}$

$F_m$ is minimal cover of F
iff ① $F_m = F$
and ② $F_m$ does not contain any redundant FD and does not contain any extraneous attribute

A $\{A \rightarrow BH,\ B \rightarrow E,\ D \rightarrow B\}$

B $\{A \rightarrow BH,\ B \rightarrow C,\ D \rightarrow B\}$

C $\{A \rightarrow BH,\ B \rightarrow CE,\ D \rightarrow B\}$

D $\{A \rightarrow B,\ B \rightarrow CE,\ D \rightarrow B\}$

#Q.9 Find the canonical cover of $F = \{ A \to BC, B \to CE, A \to E, AC \to H, D \to B \}$

Step-1 Simplify RHS

Step-2 Extraneous attribute

Step-3 Find Redundant FDs

| | | Simplify RHS | Extraneous attribute in LHS? | ⇒ Result |
|---|---|---|---|---|
| | | $A \to B$ | No | $A \to B$ |
| | | $A \to C$ | No | $A \to C$ |
| | | $B \to C$ | No | $B \to C$ |
| | | $B \to E$ | No | $B \to E$ |
| | | $A \to E$ | No | $A \to E$ |
| A | $\{A \to BH, B \to E, D \to B\}$ | $AC \to H$ | When A is present: C is Extra | $A \to H$ |
| B | $\{A \to BH, B \to C, D \to B\}$ | $D \to B$ | No | $D \to B$ |
| C | $\{A \to BH, B \to CE, D \to B\} = F$ | | | |
| D | $\{A \to B, B \to CE, D \to B\} \subset F$ | | | |

How many simplified FDs in Minimal Cover of F ⇒ Ans = 5

Find Redundant FDs

$(A)^T = \{A, C, E, B, H\}$

$(A)^+ = \{A, B, C, E, H\}$

$(B)^T = \{B, E\}$

$(B)^+ = \{B, C\}$

$(A)^T = \{A, B, C, E, H\}$

$(A)^T = \{A, B, E\}$

$(D)^T = \{D\}$

Find Result

$A \to BH$

$B \to CE$

$D \to B$

#Q.10 Consider the following FD sets

$F1 = \{A \to C, AB \to C, C \to D, C \to I, CD \to I, EC \to A, EC \to B, EI \to C\}$

$F2 = \{A \to C, C \to D, C \to I, EC \to A, EC \to B, EI \to C\}$

$F_1 \subseteq F_2$ & $F_2 \subseteq F_1$

$\therefore F_1 = F_2$

- A: F1=F2 but F2 is not a minimal cover of $F_1$
- B: F1=F2 and F2 is a minimal cover of $F_1$
- C: $F1 \subset F2$
- D: $F1 \supset F2$

& $F_2$ is irreducible

$\therefore F_2$ is Minimal cover of $F_1$

For $F_2$ to be minimal Cover of $F_1$, $F_2$ must be irreducible set of FDs

FDs of $F_2$ =
- $A \to C$
- $C \to D$
- $C \to I$
- $EC \to A$
- $EC \to B$
- $EI \to C$

} it is irreducible

#Q.11 Consider the relation R(ABCDE) with set of functional dependencies

F = { A→BC, CD→E, B→D, E→A }

How many candidate keys does the sub relation R1(ABCE) will have_ 3

{ In order to obtain the C.ks of a relation we must find the functional dependencies of that relation }

$R_1(ABCE)$

$(A)^+$ wrt. F = {A, B, C, D, E}

$(B)^+$ ... = {B, D}

$(C)^+$ ... = {C}

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

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

$(AC)^+$ = {A, B, C, D, E}

$(AE)^+$ = {A, B, C, D, E}

$(BC)^+$ = {B, C, D, E, A}

$(BE)^+$ = {A, B, C, D, E}

$(CE)^+$ = {A, B, C, D, E}

$(ABC)^+$ = {A, B, C, D, E}

$(ABE)^+$ = {A, B, C, D, E}

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

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

$R_1(A\ B\ C\ E)$

FD set $F_1$ of $R_1$ =

- $A \to BCE$ ✓ $= 2^3 - 1$
- $E \to ABC$ $= 2^3 - 1$
- $AB \to CE$ $= 2^2 - 1$
- $AC \to BE$ $= 2^2 - 1$
- $AE \to BC$ $= 2^2 - 1$
- $BC \to EA$ $= 2^2 - 1$
- $BE \to AC$ $= 2^2 - 1$
- $CE \to AB$ $= 2^2 - 1$
- $ABC \to E$
- $ABE \to C$
- $ACE \to B$
- $BCE \to A$

| | | |
|---|---|---|
| $A \to B$ | $A \to BC$ | $A \to BCE$ |
| $A \to C$ | $A \to BE$ | |
| $A \to E$ | $A \to CE$ | |

How many non-trivial FDs exists in Relation $R_1$,

⇓

$7+7+3+3+3+3+3+3+1+1+1+1$

$= 36$

Ans

C.Ks of $R_1$ = (A), (E), (BC),

Am = 3

Q:-12 Consider the following relation R(WXYZ) with set of functional dependencies

$F = \{ W \to X \to (3NF)$ (P.S.C.K, P.S.C.K)

C.K = (WZ), (XZ)

P.A = {W, X, Z}

N.P.A = {Y}

$X \to Y$ (P.S.C.K, N.P.A) $\to (1NF)$

$XY \to W$ (P.S.C.K/P.A) $\to (3NF)$

then R is

(a) Not in 2NF

(b) R is in 2NF but not in 3NF

(c) R is in 3NF but not in BCNF

(d) R is in BCNF

# 2 mins Summary

Topic Relationship between FD sets

Topic Minimal cover

Topic FD set of a sub-relation of given relation

Topic Normal forms

Slide

# THANK - YOU