COMPUTER SCIENCE

Database Management System

FD's and Normalization: Minimal cover, Lossy & Lossless join, Dependency Preserving Decomposition, Normal Forms: (1NF, 2NF, 3NF & BCNF)

Lecture_02

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Q.10 Consider the following relational schema R(ABCDEF) with functional dependency $\{AB \to C,\ C \to D,\ D \to E,\ E \to F,\ F \to B\}$ The number of candidate keys for relation R?

$[AB]^+ = [ABCDEF]$

$[A]^+ = [A]$

$[B]^+ = [B]$

AB is Candidate key — (1)

If $X_{\text{Attribute}} \to$ [Prime Attribute]

Key / Prime Attribute = [A, B, F, E, D, C]

$(BD)^+ = [BDEF]$

$E \to F$

$(AE)^+ = (AEFBCD)$

$(E)^+ = (EFB)$

AE is C.K — (3)

$C \to D$

$(AC)^+ = (ACDEFB)$

$(C)^+ = (CDEFB)$

AC is C.K — (5)

$F \to B$

$[AF]^+ = [AFBCDE]$

$(F)^+ = [FB]$

AF is C.K — (2)

$D \to E$

$(AD)^+ = [ADEFBC]$

$(D)^+ = [DEFB]$

AD is C.K — (4)

5 C.K [AB, AF, AE, AD, AC]

Q.11

R(ABCDE) {A → BC, CD → E, B → D, E → A}

Find candidate keys for the relation R ?

Prime Attribute = [A, E, C, D

Sol^n

$(A)^+ = [ABCDE]$

A is Candidate key — (1)

If $X_{Attribute} \rightarrow$ [Prime Attribute]

E → A

$[E]^+ = [EABCD]$

E is Candidate key — (2)

CD → E

$[CD]^+ = [CDEAB]$

$(C)^+ = [C]$

$(D)^+ = [D]$

CD is Candidate key — (3)

B → D

$(CB)^+ = [CBDAE]$

$(B)^+ = [BD]$

CB is C.K — (4)

A
E
CD or DC
CB or BC

4 C.K Ans

Q.12

R(ABCDEFGH)

$\{AB \to CD,\ D \to EG,\ F \to H,\ C \to EF,\ H \to A,\ G \to B,\ A \to B\}$

Find candidate keys for the relation R? key/Prime Attribute = (A, H, F, C

$(AB)^+ = [ABCDEGFH]$

$(B)^+ = (B)$

$(A)^+ = [ABCDEFGH]$

$\boxed{\text{A is Candidate key}}$ – (1)

$X_{\text{Attribute}} \to [\text{Prime Attribute}]$

$\underline{H \to A}$

$(H)^+ = (HABCDEFG)$

$\boxed{\text{H is Candidate key}}$ – (2)

$\underline{F \to H}$

$(F)^+ = (FHABCDEG)$

$\boxed{\text{F is C.K}}$ – (3)

$\underline{C \to EF}$

$(C)^+ = [CFHABDEG)$

$\boxed{\text{C is C.K}}$ – (4)

4 C.K

A
H
F
C

Q.13 Consider a relation scheme R = (A, B, C, D, E, H) on which of the following functional dependencies hold:

$\{A \rightarrow B, BC \rightarrow D, E \rightarrow C, D \rightarrow A\}$

What are the candidate keys of R?

[GATE 2M]

P.A/key Attribute = (H, A, E, D

(A) AE, BE

(B) AE, BE, DE

(C) AEH, BEH, BCH

(D) AEH, BEH, DEH

$(AE)^+ = [ABECD]$

$(AEH)^+ = [ABCDEH]$

AEH is C.K — (1)

$D \rightarrow A$

(DEH)

$BC \rightarrow D$

(BCEH)

$(BEH)^+ = (BEHCDA)$

$(CEH)^+ = [CEH)$

BEH is C.K

Q.14 Consider a relation R with five attributes V, W, X, Y, and Z. The following functional dependencies hold : VY → W, WX → Z, an ZY → V. Which of the following is a candidate key for R?

[GATE 2M]

(A) VXZ

(B) VXY

(C) VWXY

(D) VWXYZ

$(VXZ)^+ = [VXZ]$

$(VXY)^+ = (VXYWZ]$

B Ans

Q.15 Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values.

F = {CH → G, A → BC, B → CFH, E → A, F → EG} is a set of functional dependencies (FDs) so that F is exactly the set of FDs that hold for R.

[GATE 2013 : 2 marks]

How many candidate keys does the relation R have?

AD
ED
FD
BD

4 Candidate key.

(A) 3

(B) 4

(C) 5

(D) 6

Q.16 Which of the following is NOT a superkey in a relational schema with attributes V, W, X, Y, Z and primary key VY?

[GATE]

A. VXYZ

B. VWXZ

C. VWXY

D. VWXYZ

VY Any Super Set of VY is Super key.

Q.17 A prime attribute of a relation scheme R is an attribute that appears

key

[GATE]

A In all candidate keys of R.

B In some candidate key of R.

C.K = [A, M, F, C]

C In a foreign key of R.

D Only in the primary key of R.

- RDBMS Concept
- $\boxed{\text{FD \& its type}}$ $X \rightarrow y$ $\boxed{t_1.x = t_2.x \text{ then } t_1.y = t_2.y \text{ must be same}}$
- Attribute closure
- Keys Concept
- Finding Multiple Candidate key

Trivial
Non Trivial
Semi Non Trivial

Keys

Super Key

minimal → Candidate Key (Lets Assume 4 C.K)

1 Select as → Primary Key

Remaining CK → Alternative/secondary key

Finding multiple Candidate key

first we find Any One Candidate key.

$$\boxed{\text{If } X_{\text{Attribute}} \longrightarrow [\text{Prime} \mid \text{key Attribute}]}$$

then Multiple Candidate key are Possible.

Membership Set

Let F be the Given FD Set.

$F : [\ \_ \_ \_ \_ \_ \_ \_\ ]$

(Q) Any $X \to Y$ FD is a Member of FD Set F (or) Not ?

$X \to Y$ is Member of FD Set F iff $X \to Y$ Logically implied in F.

$X \to Y$ Logically implied means from the closure of X determine Y.

$[X]^+ = [\ \_ \_ \_ \_ Y\ ]$ yes its Member/Logically implied/ Valid FD.

eg $R(A \to B,\ B \to C)$

$A \to C$ is member / logically implied / valid FD for F ?

Sol^n

$$[A]^+ = (A\,B\,\underline{C})$$

$\underline{A \to C}$ is a member / logically implied.

(Q)

F: {AB → C, BC → D, D → EF}

Check [A → F] is logically implied (or) Not?

$[A]^+ = [A]$ Not logically implied

Not Member of FD set F.

Q.1 In a schema with attributes A, B, C, D and E following set of functional dependencies are given

[GATE: 2 Marks + ISRO]

$A \rightarrow B$

$A \rightarrow C$

$CD \rightarrow E$

$B \rightarrow D$

$E \rightarrow A$

$(CD)^+ = (CDEAB)$

$(BD)^+ = (BD)$

$(BC)^+ = (BCD \ldots)$

$(AC)^+ = (ACB \ldots$

Which of the following functional dependencies is NOT implied by the above set

(A) $CD \rightarrow AC$

(B) $BD \rightarrow CD$

(C) $BC \rightarrow CD$

(D) $AC \rightarrow BC$

Ans (B)

Q.2 Suppose the following functional dependencies hold on a relation U with attributes P, Q, R, S and T:

[MSQ] [GATE 2021]

$P \rightarrow QR,\ RS \rightarrow T$

Which of the following functional dependencies can be inferred from the above functional dependencies?

(C) $PS \rightarrow T$

(A) $P \rightarrow R$

$[P]^+ = [PQR]$

(D) $R \rightarrow T$

(B) $PS \rightarrow Q$

$[PS]^+ = [PSQRT$

$[PS]^+ = [PQRST$

$[R]^+ = [R]$

A, B, C

Attribute closure $[X]^+$

$[A]^+$

$[AC]^+$

Closure of FD Set $[F]^+$

Set of All possible FD's which Can be derived from given FD Set is called Closure of FD Set. $[F]^+$

$[F]^+$

$(F)^+$ Closure of FD

R(AB)

ϕ

A

B

AB

$\phi \rightarrow \phi$

$A \rightarrow \phi$

$A \rightarrow A$

$A \rightarrow B$

$A \rightarrow AB$

$B \rightarrow \phi$

$B \rightarrow A$

$B \rightarrow B$

$B \rightarrow AB$

$AB \rightarrow \phi$

$AB \rightarrow A$

$AB \rightarrow B$

$AB \rightarrow AB$

$R(ABC)$

ϕ
A
B
C
AB
BC
AC
ABC

$\phi \to \phi$

$A \to \phi$
$A \to A$
$A \to B$
$A \to C$
$A \to AB$
$A \to BC$
$A \to AC$
$A \to ABC$

$B \to \phi$
$B \to A$
$B \to B$
$B \to C$
$B \to AB$
$B \to AC$
$B \to BC$
$B \to ABC$

$R(ABC)$ $[A \to B,\ B \to C]$ $(F)^+ = 43$ Ans 2^n

ϕ 0 Attribute $\Rightarrow \phi \to \phi$ ①

A

B 1 Attribute $[A]^+ = [ABC] \Rightarrow 2^3$

C $[B]^+ = [BC] \Rightarrow 2^2$

AB $[C]^+ = [C] \Rightarrow 2^1$

BC 2 Attribute $[AB]^+ = [ABC] \Rightarrow 2^3$

AC $(BC)^+ = [BC] \Rightarrow 2^2$

ABC 3 Attribute $(AC)^+ = [ABC] \Rightarrow 2^3$

$(ABC)^+ = [ABC] = 2^3$

⑧ $[A \to \phi,\ A \to A,\ A \to B,\ A \to C,\ A \to AB,\ A \to BC,\ A \to AC,\ A \to ABC]$

④ $[B \to \phi,\ B \to B,\ B \to C,\ B \to BC]$

② $[C \to \phi,\ C \to C]$

⑧ $[AB \to \phi,\ AB \to A,\ AB \to B,\ AB \to C,\ AB \to AB,\ AB \to BC,\ AB \to AC,\ AB \to ABC]$

④ $[BC \to \phi,\ BC \to B,\ BC \to C,\ BC \to BC]$

⑧ $[AC \to \phi,\ AC \to A,\ AC \to C,\ AC \to B,\ AC \to AB,\ AC \to BC,\ AC \to AC,\ AC \to ABC]$

⑧ $ABC \to \phi$

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$ABC \to \phi$, $ABC \to A$, $ABC \to B$, $ABC \to C$

$ABC \to AB$, $ABC \to BC$, $ABC \to AC$

$ABC \to ABC$

$R(AB)$ $\{A \to B\}$

ϕ 0 Attribute $= 1$ — 1

A 1 Attribute $(A)^+ = (AB) = 2^2$ — 4 — $\{A \to \phi,\ A \to A,\ A \to B,\ A \to AB\}$

B $(B)^+ = (B) = 2^1$ — 2 — $\{B \to \phi,\ B \to B\}$

AB 2 Attribute $(AB)^+ = (AB) = 2^2$ — 4 — $\{AB \to \phi,\ AB \to A,\ AB \to B,\ AB \to AB\}$

11 Ans

Equality between 2 FD set

F: [- - - - - - - -]   G: [- - - - - - - - -]

$\boxed{F \equiv G}$?

F & G equal only iff $[F]^+ \equiv [G]^+$

$F : [\ \_\ \_\ \_\ \_\ \_\ ]$

$G : [\ \_\ \_\ \_\ \_\ ]$

$\boxed{F \equiv G}$

F and G are equal only iff

F Cover G : True

G Cover F : True

F Cover G :	True	True	False	False
G Cover F :	True	False	True	False
	$\boxed{F \equiv G}$	$\boxed{F \supset G}$	$\boxed{G \supset F}$	Uncomparable

F Cover G : F Cover All the FD's of G

→ All the Dependency (FD's) of G is logically implied (member) of 'F' FD Set.

G Cover F : G Cover all the FD of F.

→ All the FD's of F is logically implied in G FD Set.

Q.3

Consider relation schema A(P Q R S) with two set of FD's

F : [P →Q, PQ → R, PR → S, Q → R, Q → P]

G : [PQ → S, PR → Q, Q → S, QS → R]

Which of the following is correct?

(A) F Cover G

(B) G Cover F

(C) F and G are equivalent

(D) None of these

F Cover G

PQ → S [PQ]$^+$ = [PQRS]

PR → Q [PR]$^+$ = [PRQ....]

Q → S [Q]$^+$ = [QRPS]

QS → R [QS]$^+$ = [QSRP]

True

G Cover F

P → Q [P]$^+$ = [P]

PQ → R [PQ]$^+$ = [PQSR

PR → S [PR]$^+$ = [PRQS

Q → R [Q]$^+$ = [QSR

Q → P [Q]$^+$ = [QSR

False

Q.4 Consider relation schema R(A C D E H) with two set of FD's

[MSQ]

F : [$A \to C$, $AC \to D$, $E \to AD$, $E \to H$]

G : [$A \to CD$, $E \to AH$]

Which of the following is correct?

$\boxed{F \equiv G}$

(A) F Cover G

(B) G Cover F

(C) F and G are equivalent

(D) None of these

Minimal Cover

↳ eliminate extra (Redundant) FD.

Extra (Redundant FD): Extra FD is a FD if we Delete that from FD Set then after Deletion, No Effect on FD Set F.

F: [A → B, B → C, A → C]

A → C is extra (Redundant) FD.

G: [A → B, B → C]

$[A]^+ = [ABC]$

A → C is extra FD.

Minimal Cover

Canonical Cover

- Sets of functional dependencies may have redundant dependencies that can be inferred from the others
  - For example: $A \to C$ is redundant in: $\{A \to B, B \to C, A \to C\}$

$G: (A \to B, B \to C)$

$[A]^+ = [ABC]$

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

Assume $A \to C$ is R.F.D

$\boxed{G: \{A \to B,\ B \to C\}}$

$\boxed{\text{Iff } F \equiv G}$ — F Cover G : True; G Cover F : True

We Conclude $A \to C$ is R.F.D

F Cover G

$A \to B$ ✓ $(A)^+ = \{ABC\}$

$B \to C$ ✓ $(B)^+ = \{BC\}$

True

G Cover F

$A \to B$ $(A)^+ = \{ABC\}$

$B \to C$ $(B)^+ = \{BC\}$

$A \to C$ $(A)^+ = \{ABC\}$

True

$\boxed{F \equiv G}$

$A \to C$ is R.F.D

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

Lets Assume $B \to C$ is R.F.D

$B \to C$ is Not extra FD.

$\boxed{G: \{A \to B, A \to C\}}$

F Cover G

✓ $A \to B$ $(A)^+ = \{ABC$

✓ $A \to C$ $(A)^+ = \{ABC\}$

True

G Cover F

✓ $A \to B$ $(A)^+ = \{ABC\}$

✗ $B \to C$ $[B]^+ = \{B\}$

✓ $A \to C$ $(A)^+ = \{ABC\}$

False

Q.5 $AB \rightarrow C$, $D \rightarrow E$, $E \rightarrow C$ is a minimal cover for the set of functional dependencies $AB \rightarrow C$, $D \rightarrow E$, $AB \rightarrow E$, $E \rightarrow C$.

Not

[GATE 2013]

$F: [AB \rightarrow C,\ D \rightarrow E,\ AB \rightarrow E,\ E \rightarrow C]$

$G: [AB \rightarrow C,\ D \rightarrow E,\ E \rightarrow C]$.

F Cover G

✓ $\cancel{AB} \rightarrow C$ — $(AB)^+ = [ABC \ldots]$

✓ $\cancel{D} \rightarrow E$ — $(D)^+ = [DE \ldots]$

✓ $\cancel{E} \rightarrow C$ — $(E)^+ = [EC \ldots]$

True

G Cover F

✓ $\cancel{AB} \rightarrow C$ — $(AB)^+ = [ABC$

✓ $\cancel{D} \rightarrow E$ — $(D)^+ = [DE)$

× $AB \rightarrow E$ — $(AB)^+ = [ABC)$

✓ $\cancel{E} \rightarrow C$ — $(E)^+ = [EC)$

False

Procedure

Step 1 R.H.S 'single Attribute' (eg $A \rightarrow BC$
($A \rightarrow B$, $A \rightarrow C$))

Step 2 Find Redundant FD & Delete them

Step 3 L.H.S Redundant Attribute

Procedure to find minimal set

Step

(1) Split the FD such that RHS contain single Attribute.

Ex. $A \to BC, \quad \Rightarrow \quad A \to B$ and $A \to C$

Step

(2) Find the redundant FD and delete them from the set

Ex. $\{A \to B,\ B \to C,\ \cancel{A \to C}\}$

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

Step

(3) Find the redundant attribute on L.H.S and delete them.

Ex. $AB \rightarrow C$, A – Can be deleted $[B]^{+} = [A]$

extra

B^{+} Contains 'A'

B can be delete if A^{+} contain 'B' $[A]^{+} = [\ldots B]$

extra

$xy \longrightarrow z$

In xy

When x extra $\Rightarrow (y)^+ = [\ldots\ldots\ x]$

When y extra $\Rightarrow (x)^+ = [\ldots\ldots\ y]$

xample:

$$[A \to C,\ AC \to D,\ E \to AD,\ E \to H]$$

Step 1 R.H.S

$A \to C,\ AC \to D,\ E \to A,\ E \to D,\ E \to H$

$E \to D$ is extra FD.

Step 2 find Extra (Red.) FD.

$A \to C$ | $AC \to D$ | $E \to A$ | $\cancel{E \to D}$ | $E \to H$

$[A]^+ = [A]$ $[AC]^+ = [AC]$ $(E)^+ = (EDH)$ $(E)^+ = [EHACD]$ $(E)^+ = (EACD)$

Step 3

$A \to C,\ AC \to D,\ E \to A,\ E \to H$

$(C)^+ = (C)$ A is Not extra

$AC \to D.$

$ABC \to D$

C is extra if $(A)^+ = (\ldots C)$

A is extra if $[C]^+ = (\ldots A)$

$(A)^+ = [AC]$ C is extra

$\boxed{A \to C,\ A \to D,\ E \to A,\ E \to H}$ Ans

or

$\boxed{A \to CD,\ E \to AH}$ Ans

FD

↓

Attribute closure → Member Ship Set

Attribute closure

↓

Super key

↓ minimal

Candidate key

↓

Multible C.K

Member Ship Set

↓

FD Closure set

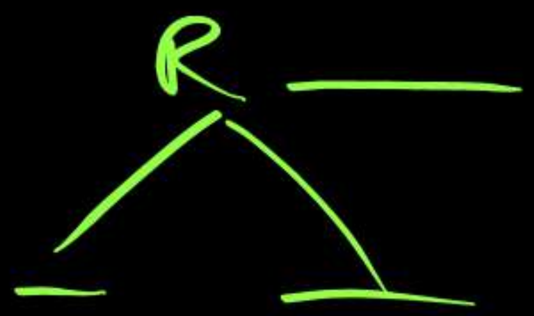
↓

Equality b/w 2 FD Set

↓

Minimal Cover

Normal Form



Lossless Join

Dependency Preserved

Properties of Decomposition

1. Lossless Join
2. Dependency Preserving

Lossless Join

R is Decomposed into Sub Relation $R_1 R_2 \ldots R_n$

If $R_1 \bowtie R_2 \bowtie R_3 \ldots \bowtie R_n \equiv R$
Lossless Join

If $R_1 \bowtie R_2 \bowtie R_3 \ldots \bowtie R_n \supset R$
Lossy Join

Lossless – Join Decomposition

- For the case of $R = (R_1, R_2)$, we require that for all possible relations r on schema R

$$\boxed{r = \pi_{R_1}(r) \bowtie \pi_{R_2}(r)}$$

- A decomposition of R into R_1 and R_2 is lossless join if at least one of the following dependencies is in F^+:
  - $R_1 \cap R_2 \rightarrow R_1$
  - $R_1 \cap R_2 \rightarrow R_2$

$\bowtie$ Natural Join ($\bowtie$) R $\bowtie$ S.

Step1 CROSS Product (Cartesian Product) of R & S.

R	S
n_1 Tuple	n_2 Tuple
c_1 Attribute	c_2 Attribute

$$\boxed{R \times S \Rightarrow \begin{array}{l} n_1 \times n_2 \text{ Tuple} \\ c_1 + c_2 \text{ Attribute} \end{array}}$$

Step2 Select the Tuple which satisfy equality condition on all common Attribute from RXS.

Step3 Projection of Distinct Attribute.

$$R \bowtie S = \pi_{\substack{\text{Distinct} \\ \text{Attribute}}}\left[\sigma_{\substack{\text{equality condition} \\ \text{on all Common} \\ \text{Attribute}}}(R \times S)\right]$$

Q.

R(ABC)

$A \to B$ ✓, $A \to C$, $\cancel{B \to C}$

A	B	C
1	5	5
2	5	8
3	8	8

Decomposed into

Q.1 $R_1(AB)$ & $R_2(BC)$

Q.2 $R_1(AB)$ & $R_2(AC)$

$[A]^+ = [AB\,.]$ lossless

Super key of R_1

$(B)^+ = (B)$ Lossy.

A	B
1	5
2	5
3	8

B	C
5	5
5	8
8	8

Tuple : Attrib.

3 Tuple 2 Att

$3 \times 3 = 9$ Tuple

$2 + 2 = 4$ Attribute

A	B	C
1	5	5
1	5	8
2	5	5
2	5	8
3	8	8

Lossy Join

Step 1

$R_1.A$	$R_1.B$	$R_2.B$	$R_2.C$
1	5	5	5
1	5	5	8
1	5	8	8
2	5	5	5
2	5	5	8
2	5	8	8
3	8	5	5
3	8	5	8
3	8	8	8

Q.

R(ABC)

A	B	C
1	5	5
2	5	8
3	8	8

Decomposed into

Q.1 $R_1(AB)$ & $R_2(BC)$

Q.2 $R_1(AB)$ & $R_2(AC)$

A	B
1	5
2	5
3	8

A	C
1	5
2	8
3	8

Step 1

Step 2

$R_1.A = R_2.A$

$R_1.A$	$R_1.B$	$R_2.A$	$R_2.C$
1	5	1	5
1	5	2	8
1	5	3	8
2	5	1	5
2	5	2	8
2	5	3	8
3	8	1	5
3	8	2	8
3	8	3	8

A	B	C
1	5	5
2	5	8
3	8	8

Lossless

Lossless Join:

Let R be the Relation schema with FD set is Decomposed into SubRelation R_1 & R_2

$R_1 \bowtie R_2$ is Lossless

① $R_1 \cup R_2 \equiv R$

② If Common Attribute of R_1 & R_2 either Super key of R_1 or Super key of R_2

$[R_1 \cap R_2]^+ \longrightarrow R_1$

or

$[R_1 \cap R_2]^+ \longrightarrow R_2$

Lossy Join

1. If Common Attribute of R_1 & R_2 neither a Super key of R_1 $\quad [R_1 \cap R_2]^+ \not\to R_1$

   nor

   Super key of R_2 $\quad [R_1 \cap R_2]^+ \not\to R_2$

2. $R(ABCDEF)$

   $R_1(ABC) \qquad R_2(DEF)$

   $\Big\}$ Lossy Bcz No Common Attribute

3. $R(ABCDE)$

   $R_1(ABC) \qquad R_2(BCD)$

   Lossy Bcz Attribute 'E' missing

$R(ABC)$ $[A \to B]$

$R_1(AB)$ $R_2(AC)$

Soln

(1) $R_1(AB) \cup R_2(AC) \Rightarrow [ABC]$

$R_1(AB) \cap R_2(AC) \Rightarrow [A]$

$[A]^+ = [AB]$ Super key of R_1

Lossless Join

$R(ABC)$ $[A \to B]$

$R_1(AB)$ $R_2(BC)$

(1) $R_1(AB) \cup R_2(BC) = ABC$

(2) $R_1(AB) \cap R_2(BC) = B$

$[B]^+ = [B]$ Not a Super key of R_1 or R_2

Lossy Join

Q. R(ABCDEFG) $\{AB \to CD,\ D \to E,\ E \to FG\}$

Decomposed into R_1(ABCD) and R_2(DEFG)

Soln

Step 1 $R_1(ABCD) \cup R_2(DEFG) \ni R(ABCDEFG)$

Step 2 $R_1(ABCD) \cap R_2(DEFG) \ni (D)$

$[D]^+ = [DEFG]$ Super key of R_2.

Lossless Join

Q. $R(ABCDEFG)$ $\{AB \rightarrow C,\ C \rightarrow D,\ D \rightarrow EFG\}$

Decomposed into $R_1(ABCE)$ and $R_2(DEFG)$

Step 1 $R_1(ABCE) \cup R_2(DEFG) \ni R(ABCDEFG)$

Step 2 $R_1(ABCE) \cap R_2(DEFG) \ni [E]$

$[E]^+ = [E]$ Neither super key of R_1 nor R_2

Lossy Join

Q. Consider the relation R(P, Q, S, T, X, Y, Z, W) with the following functional dependencies

GATE: 2 marks

$PQ \rightarrow X$; $P \rightarrow YX$; $Q \rightarrow Y$; $Y \rightarrow ZW$

Consider the decomposition of the relation R into the constituent relations according to the following two decomposition schemes.

Lossless

D_1: R = [(P, Q, S, T); (P, T, X); (Q, Y); (Y, Z, W)]

R_1, R_2, R_3, R_4

$R_1(PQST) \cap R_2(PTX) \Rightarrow PT$

$(PT)^+ = (PTYX)$

D_2 : R = [(P, Q, S); (T, X); (Q, Y); (Y, Z, W)]

Which one of the following options is correct?

$R_{12}(PQSTX) \cap R_3(QY)$

$(Q)^+ = (QY\text{---})$

$R_{123}(PQSTXY) \cap R_4(YZW)$

$(Y)^+ = (YZW)$

(A) D_1 is a lossy decomposition, but D_2 is a lossless decomposition.

(B) Both D_1 and D_2 are lossless decompositions.

(C) Both D_1 and D_2 are lossy decompositions.

(D) D_1 is a lossless decomposition, but D_2 is a lossy decomposition.

R - - - - R_1 R_2 R_3 - - - - R_n

F_1 F_2 F_3 F_n

$$\boxed{\text{If } F_1 \cup F_2 \cup F_3 \ldots\ldots \cup F_n \equiv F}$$

Dependency Preserved.

$R(ABCD)$ $\{A \to B, \; C \to D\}$

Non Trivial

$R_1(AB), \quad R_2(CD)$

AB	CD
$A \to B$	$C \to D$

$(A)^+ = (A)$

$(B)^+ = (B)$

$(C)^+ = (CD)$

$(D)^+ = (D)$

F1 F2

$A \to B \cup C \to D$

$F: [\quad]$

Non Trivial

$R_1(\ )$	$R_2(\ )$	$R_3(\ )$

Dependency Preservation

- Let F_i be the set of dependencies F^+ that include only attributes in R_i.
  - A decomposition is dependency preserving, if

    $(F_1 \cup F_2 \cup \ldots \cup F_n) = F^+$

Q. Consider a schema R(A, B, C, D) and functional dependencies $\boxed{A \rightarrow B \text{ and } C \rightarrow D}$. Then the decomposition of R into $R_1(AB)$ and $R_2(CD)$ is

$R_1(AB)$ $R_2(CD) \Rightarrow$ Lossy

(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

$R_1(AB)$	$R_2(CD)$
$A \rightarrow B$	$C \rightarrow D$

$(A)^+ = (AB)$

$(B)^+ = (B)$

$(AB)^+ = (AB$

$(C)^+ = (CD)$

$(D)^+ = (D)$

$(CD)^+ = (CD)$

Q. Let R(A, B, C, D) be a relational schema with the following function dependencies:

$A \rightarrow B$, $B \rightarrow C$, $C \rightarrow D$ and $D \rightarrow B$.

The decomposition of R into (A, B), (B, C), (B, D)

(A) Gives a lossless join, and is dependency preserving

(B) Gives a lossless join, but is not dependency preserving

(C) Does not give a lossless join, but is dependency preserving

(D) Does not give a lossless join and is not dependency preserving

AB	BC	BD
$A \rightarrow B$	$B \rightarrow C$	$D \rightarrow B$

$C \rightarrow D$

$C \rightarrow B$ & $B \rightarrow D$

$(C)^+ = [CDB]$ $(B)^+ = [BCD]$

$A \to B$, $\cancel{B \to C}$, $C \to D$, $\cancel{D \to B}$

R_1 AB	R_2 BC	R_3 BD
$A \to B$	$B \to C$	$B \to D$
	$C \to B$	$D \to B$

Non Trivial FD & Domain

$(A)^+ = (ABCD)$

$(B)^+ = (BCD)$

$(C)^+ = (CDB)$

$(D)^+ = (DB)$

$F_1 \cup F_2 \cup F_3$

$(\cancel{A \to B}, \cancel{B \to C}, C \to B, B \to D, \cancel{D \to B})$

$C \to D$

Whenever Any Attribute Not Present in FD then Make a Part of Candidate Key.

$R(ABCEF)$ $\{AB \to CD,\ CD \to E\}$

$[AB]^+ = [ABCDE]$

F is Not Present in dependent or determinant then add (Make a part) in Candidate key.

$[ABF]^+ = [ABCDEF]$

AF

AB

BF

$[AF]^+ = [AF]$

$[BF]^+ = [BF]$

$\boxed{ABF \text{ is C.K}}$ Ans

RDBMS Concept

FD & its type

Keys Concept (Superkey, Candidate key, P.K, A.K/S.K)

Finding Multiple Candidate Key.

THANK YOU!