COMPUTER SCIENCE

Database Management System

FD's & Normalization

Lecture_05

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TOPICS TO BE COVERED

01 Membership Set

02 Equality between FD Set

RDBMS Concept

- Arity / Degree : (# Attributes)
- Cardinality : (# Tuples)
- Relational Schema.
- Relational Instance

Type of FD

1. Trivial FD
2. Non Trivial FD
3. semi Non Trivial FD

FD [Functional Dependency]

$X \rightarrow y$ If $t1.X = t2.X$ then $t1.y = t2.y$ must be same.

Attribute closure $[X]^+$

Keys Concept

↳ Super key

↳ Candidate key

Key/Prime Attribute

Non key | Non Prime Attribute

Finding Multiple C.K

$\boxed{\text{If } X_{\text{Attribute}} \rightarrow [\text{Prime Attribute}] \quad \text{Multiple CK Possible.}}$

(a) CC with Enjoying Chamatkar Concept

(b) CC

(c) C

(d) Doubt

Q.13 5 CK

ABG

BEG

FG

DG

CG

Doubt ?

Q.14 A

DE

B

A	B	C	D
1	5	4	8
2	6	5	8
2	9	6	7
3	8	4	4

(1) Candidate key = B

(2) AC, (3) AD, (4) CD

Candidate key → Primary key
Candidate key → Alternate/secondary key.

BC : Super key

Not Candidate key

Note

(1) At Most One Primary key Per Table.

P.K (Unique + NOT NULL)

(2) More than One Alternative/secondary key Possible.

Membership set :

F: [. - - - . . .]

Let F be the Given FD set. Any $X \to Y$ FD is a member of FD set F iff $X \to Y$ logically implied in F.

$X \to Y$ logically implied means $[X]^+$ determines Y. then we can say $X \to Y$ is a Member/Logically implied/Valid FD in FD Set F.

Q) F: {A → B, B → C}

Check $\boxed{A \to C}$ is Member or Not ?

Soln)

$[A]^+ = [ABC]$

A → C is Member / Valid FD / Logically implied in FD set F.

$F: \{AB \to C,\ D \to BE,\ C \to EA,\ D \to F\}$

✓ (i) $AB \to E$	$[AB]^+ = \{ABC\underline{E}$
✗ (ii) $D \to C$	$(D)^+ = \{DBEF$
✓ (iii) $C \to A$	$(C)^+ = \{CE\underline{A} \ldots$
✗ (iv) $BD \to A$	$(BD)^+ = \{BDEF$

Which FD's is/are logically implied?

(i) YES

(iii) YES

$F: [AB \to C,\ A \to DE,\ B \to F,\ F \to GH,\ D \to IJ]$

✓ (i) $A \to J$ $\quad (A)^+ = [ADEIJ]$

✗ (ii) $B \to I$ $\quad (B)^+ = [BFGH]$

✗ (iii) $B \to GI$ $\quad (B)^+ = [BFGH]$

✓ (iv) $AB \to GH$ $\quad (AB)^+ = [ABCDEFGHIJ]$

✗ (v) $F \to IJ$ $\quad (F)^+ = [FGH]$

✗ (vi) $B \to CD$ $\quad (B)^+ = [BFGH]$

$\boxed{\text{(i) \& (iv)}}$ Ans

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

$A \rightarrow B$

$A \rightarrow C$

$CD \rightarrow E$

$B \rightarrow D$

$E \rightarrow A$

$(CD)^+ = (CDEAB)$

$(BD)^+ = (BD)$

$(BC)^+ = (BCDEA)$

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

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

[MCQ: GATE - 2M]

[ISRO-3M]

(A) $BD \rightarrow CD$ Not Implied

(B) $AC \rightarrow BC$ Implied

(C) $CD \rightarrow AC$ Implied

(D) $BC \rightarrow CD$ Implied

$\boxed{\text{Ans (A)}}$

Q.

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

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

$(RS)^+ = [RST]$

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

[MSQ: 2021 - 2M]

(A) $PS \rightarrow T$ — $(PS)^+ = [PQRST]$

(B) $R \rightarrow T$ — $(R)^+ = [R]$

(C) $P \rightarrow R$ — $(P)^+ = [PQR]$

(D) $PS \rightarrow Q$ — $(PS)^+ = [PSQRT]$

Ans (A) [C] & [D]

Equality between FD set

F: [. . . . . . .]   G : [. . . . . . .]

Let F & G be the FD set.

$\boxed{F \equiv G}$ F & G are equals only if

F Cover G : True

G Cover F : True.

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

OR

All G FD's should be Logically implied in F FD Set.

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

OR

ALL F FD's Should be Logically implied in G FD Set.

F Cover G :	True	False	True	False
G Cover F :	False	True	True	False
	$F \supset G$	$G \supset F$	$F \equiv G$	Uncomparable

$F: [AB \to CD,\ B \to C,\ C \to D]$

$G: [AB \to C,\ AB \to D,\ C \to D]$

F Cover G

✓ $AB \to C$ $\quad (AB)^+ = [ABCD]$

✓ $AB \to D$ $\quad (AB)^+ = [ABCD]$

✓ $C \to D$ $\quad (C)^+ = [CD]$

True

G Cover F

✓ $AB \to CD$ $\quad (AB)^+ = [ABCD]$

✗ $B \to C$ $\quad (B)^+ = [B]$

✓ $C \to D$ $\quad (C)^+ = [CD]$

False

$\boxed{F \supset G.}$

Ans

Q.

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

F : [$P \rightarrow Q$, $PQ \rightarrow R$, $PR \rightarrow S$, $Q \rightarrow R$, $Q \rightarrow P$]

G : [$PQ \rightarrow S$, $PR \rightarrow Q$, $Q \rightarrow S$, $QS \rightarrow R$]

Which of the following is correct?

A. F Cover G

B. G Cover F

C. F and G are equivalent

D. None of these

Ans (A)

$F: [P \to Q,\ PQ \to R,\ PR \to S,\ Q \to R,\ Q \to P]$

$G: [PQ \to S,\ PR \to Q,\ Q \to S,\ QS \to R]$

F Cover G

✓ $PQ \to S$ $\quad (PQ)^+ = [PQRS$

✓ $PR \to Q$ $\quad (PR)^+ = [PRQS]$

✓ $Q \to S$ $\quad (Q)^+ = (QRPS]$

✓ $QS \to R$ $\quad (QS)^+ = [QSRP]$

True

G Cover F

× $P \to Q$ $\quad (P)^+ = [P]$

✓ $PQ \to R$ $\quad (PQ)^+ = [PQSR)$

✓ $PR \to S$ $\quad (PR)^+ = (PRQS)$

✓ $Q \to R$ $\quad (Q)^+ = [QSR)$

× $Q \to P$ $\quad (Q)^+ = [QSR]$

False.

Q.

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

[MSQ]

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

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

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: {A → C, AC → D, E → AD, E → H}

G: {A → CD, E → AH}

F Cover G

✓ A → CD $(A)^+ = \{ACD$

✓ E → AH $(E)^+ = \{EADHC\}$

True

$\boxed{F \equiv G}$

G Cover F

✓ A → C $(A)^+ = \{ACD\}$

✓ AC → D $(AC)^+ = \{ACD\}$

✓ E → AD $(E)^+ = \{EAHCD\}$

✓ E → H

True

Minimal cover : The objective of Minimal Cover is Elimination of Redundant FD (R.FD)/Extra FD. & R. Attribute.

Redundant FD (R.F.D) is a FD if we Delete that FD From original FD set (F) then After Deletion does not effect the Power of FD Set.

$F : [A \to B,\ B \to C,\ A \to C]$

$\boxed{\text{Assume Here } A \to C \text{ is R.F.D.}}$; After Deletion of $A \to C$ FD from Original FD set. then from New FD set

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

$(A)^+ = (ABC)$

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

$\boxed{A \to C \text{ is R.F.D.}}$

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

Minimal Cover : $A \to B,\ B \to C$.

$F \equiv G$? F cover G, G cover F

$F: [A \to B,\ B \to C,\ A \to C]$

(i) Lets Assume $A \to B$ is RFD

$G: [B \to C,\ A \to C]$

F Cover G

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

True

G Cover F

$\times\ A \to B$ $\quad (A)^+ = (AC)$
$B \to C$
$A \to C$

False

$\therefore A \to B$ is Not R.F.D.

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

$G: [A \to B,\ A \to C]$

F Cover G

$\checkmark A \to B$
$\checkmark A \to C$

True

G Cover F

$\checkmark A \to B$ $\quad (A)^+ = (ABC)$
$\times\ B \to C$ $\quad (B)^+ = (B)$
$\checkmark A \to C$

False

$\therefore B \to C$ is Not R.F.D

(iii) Assume $A \to C$ is R.F.D

$G: [A \to B,\ B \to C]$

F Cover G

$\checkmark A \to B$
$\checkmark B \to C$

True

G Cover F

$\checkmark A \to B$ $\quad (A)^+ = (ABC)$
$\checkmark B \to C$ $\quad (B)^+ = (BC)$
$\checkmark A \to C$ $\quad (A)^+ = (ABC)$

True

$\boxed{F \equiv G}$

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

Minimal cover: $A \to B,\ B \to C$

if FD Set is given & Minimal Cover is given then

How to check ?

$\boxed{F \equiv G}$

- F Cover G : True
- G Cover F : True.

Canonical Cover

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

Q. $AB \to C$, $D \to E$, $E \to C$ is a minimal cover for the set of functional dependencies [$AB \to C$, $D \to E$, $AB \to E$, $E \to C$.]

F:

Minimal Cover.

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

G: [$AB \to C$, $D \to E$, $E \to C$]

$\boxed{\text{Check } F \equiv G \text{ ?}}$

F Cover G

✓ $AB \to C$ $(AB)^+ = [ABC\,E..]$

✓ $D \to E$ $(D)^+ = [DE$

✓ $E \to C$ $(E)^+ = [EC]$

True

$\boxed{\text{FALSE}}$

G Cover F

✓ $AB \to C$ $(AB)^+ = [ABC]$

✓ $D \to E$ $(D)^+ = [DEC]$

✗ $AB \to E$ $(AB)^+ = [ABC]$

$E \to C$ $(E)^+ = [EC]$

False

Q.

Given the following two statements:

S1: Every table with two single-valued attributes is in 1NF, 2NF, 3NF and BCNF.

S2: $AB \rightarrow C, D \rightarrow E, E \rightarrow C$ is a minimal cover for the set of functional dependencies $AB \rightarrow C,\ D \rightarrow E, AB \rightarrow E, E \rightarrow C$.

Which one of the following is CORRECT?

[MCQ: 2014: 2M]

A. S1 is TRUE and S2 is FALSE.

B. Both S1 and S2 are TRUE.

C. S1 is FALSE and S2 is TRUE.

D. Both S1 and S2 are FALSE.

THANK YOU!