COMPUTER SCIENCE

Database Management System

FD's & Normalization

Lecture_07

Vijay Agarwal sir

01 Minimal Cover

RDBMS Concept

FD Concept & its Type

Attribute closure

Key Concept
- Super key
- Candidate key
- Finding Multiple CK

- Membership Set
- Equality b/w 2 FD Set

Minimal Cover

Q.

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

F : [A → C, AC → D, E → AD, E → H]

G : [A → CD, E → AH]

[MSQ]

Which of the following is correct?

A. F Cover G

B. G Cover F

C. F and G are equivalent

D. None of these

Any (A, B, C)

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

G Cover F

A→C $[A]^+ = [ACD]$

AC→D $[AC]^+ = [ACD]$

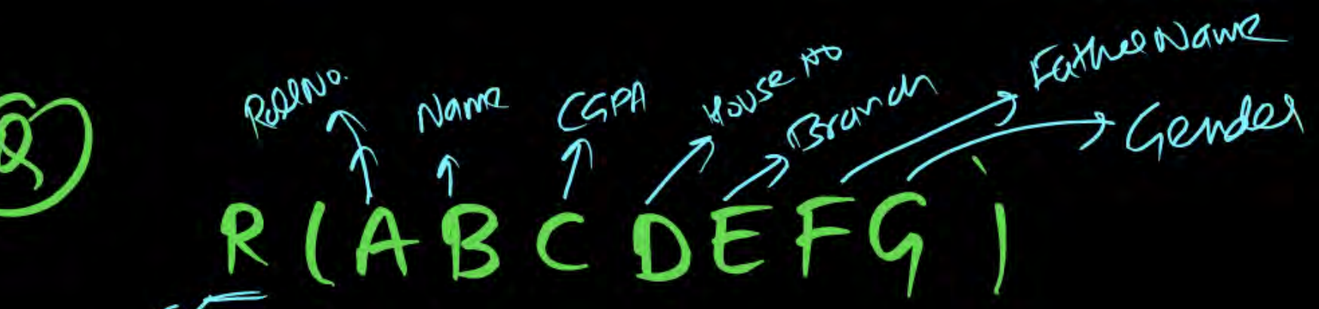
E→AD $[E]^+ = [EAHCD]$

E→H $[E]^+ = [EAHCD]$

True

$F \equiv G$

Q



$[A \to B,\ A \to C,\ A \to F,\ F \to D,\ A \to EG]$

$(A)^+ = [ABCFDEG) = [ABCDEFG]$

A (Roll No) is Candidate key.	Ans

Minimal Cover

Objective : of the Minimal is eliminate/Reduce the Redundant FD [Extra FD].

Redundant FD [R.F.D] : R.F.D is a FD if we Delete that FD from the Original FD Set, then After Deletion does not effect the POWER OF FD Set.

Q. F: [A → B, B → C, A → C]

A → C is Extra [Redundant] FD.

G: [A → B , B → C]

$[A]^+ = [ABC]$ So A → C is Extra (RFD) FD.

Minimal/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: $\{A \rightarrow B, B \rightarrow C, A \rightarrow C\}$

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

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

$(A)^+ = [ABC]$ $A \rightarrow C$ is R.F.D

Q. How to Cross check your Answer is Correct or Not ?

Soln: Check Equality

F Cover G : True

G Cover F : True

if $F \equiv G$ then the Answer is Correct

F: Given FD Set [Question]

G: Minimal Cover of the F [of the Question]

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

(i) Assume Let $A \to B$ is R.F.D

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

F Cover G

$B \to C$

$A \to C$

True

G Cover F

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

$B \to C$

$A \to C$

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

$A \to B$

$A \to C$

True

G Cover F

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

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

$A \to C$

False

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

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

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

F Cover G

$A \to B$

$B \to C$

True

G Cover F

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

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

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

True

$F \equiv G$

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

So $A \to B,\ B \to C$ is the minimal cover

for Doubt Solving

Vijay Sir

1. Telegram
2. In the Mid when Question Complete
3. In the last I ask Any Doubt.
4. Doubt Engine

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

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

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

F Cover G

- $AB \rightarrow C$ $(AB)^+ = [ABCE$
- $D \rightarrow E$ $(D)^+ = [DEC]$
- $E \rightarrow C$ $(E)^+ = [EC]$

True

G Cover F

- $AB \rightarrow C$ $(AB)^+ = [ABC]$
- $D \rightarrow E$ $(D)^+ = [DEC]$
- $AB \rightarrow E$ $(AB)^+ = [ABC]$
- $E \rightarrow C$ $(E)^+ = [EC]$

False

Not Minimal Cover

Q.

Given the following two statements:

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

False

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]

S_2 : is False

(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.

Q.

The following functional dependencies hold true for the relational schema R{V, W, X, Y, Z}:

$V \rightarrow W$
$VW \rightarrow X$
$Y \rightarrow VX$
$Y \rightarrow Z$

Which of the following is irreducible equivalent for this set of functional dependencies? [MCQ:2017: 1M]

A
$V \rightarrow W$
$V \rightarrow X$
$Y \rightarrow V$
$Y \rightarrow Z$

B
$V \rightarrow W$
$W \rightarrow X$
$Y \rightarrow V$
$Y \rightarrow Z$

C
$V \rightarrow W$
$V \rightarrow X$
$Y \rightarrow V$
$Y \rightarrow X$
$Y \rightarrow Z$

D
$V \rightarrow W$
$W \rightarrow X$
$Y \rightarrow V$
$Y \rightarrow X$
$Y \rightarrow Z$

Minimal cover Finding Procedure.

Step 1: Split the FD Such that R.H.S (Right Hand Side) Contain Single Attribute.

$A \rightarrow BC \Rightarrow A \rightarrow B,\ A \rightarrow C$

Step 2: Find the Redundant Attribute on L.H.S & Delete them

$AB \rightarrow C$; A is extra $(B)^+ = [\ldots A]$; $(B)^+$ contains A

B is extra $(A)^+ = [\ldots B]$; $(A)^+$ contain B.

Karthi

$AB \rightarrow C$; A is extra if $B \rightarrow C$.

$AB \rightarrow C$; B is extra if $A \rightarrow C$.

Step 3: Find the Redundant FD & Delete them From FD Set.

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

$A \to C$ is Redundant FD.

Procedure to find minimal set

Step (1)

Split the FD such that RHS (Right Hand Side) contain single Attribute.

Ex. $A \rightarrow BC \quad \Rightarrow \quad A \rightarrow B$ and $A \rightarrow C$

Step (2)

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

Ex. $AB \rightarrow C$

A – Can be deleted $[B]^+=[A]$ B^+ Contains 'A' (Extra)

OR

B can be delete if A^+ contain 'B' $[A]^+=[\ldots B]$ (Extra)

Step

(3)

Find the redundant FD and delete them from the set

Ex. $\{A \rightarrow B,\ B \rightarrow C,\ A \rightarrow C\}$

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

Example1:

$[AB \rightarrow CD,\ A \rightarrow E,\ E \rightarrow C]$

Example 2:

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

Step 1: Split the FD such that R.H.S Contain Single Attribute.

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

Step 2: Find the Redundant Attribute [Extra Attribute] on L.H.S & Delete them From FD.

xx → D

$AC \to D$

C is extra

$A \to D$

Navathe, Ullmann

$[A]^+ = [ACD]$; C is extra.

$[C]^+ = [C]$; A is Not extra.

Korth

$[A]^+ = [AC\ D]$

$[C]^+ = [C]$

C is Extra

Step3 Find the Redundant [Extra FD] FD & Delete from FD set.

① $A \to C$ ② $A \to D$ ③ $E \to A$ ④ $E \to D$ ⑤ $E \to H$

$[A]^+ = [AD]$ $[A]^+ = [AC]$ $[E]^+ = [EDH]$ $[E]^+ = [EAHCD]$ $[E]^+ = [EACD]$

Minimal Cover: $A \to C$ $A \to D$ $E \to A$ $E \to H$

OR

Minimal Cover: $A \to CD$, $E \to AH$

② $[A \to C, AC \to D, E \to AD, E \to H]$

Q How to Find Extra FD (Redundant FD) Directly ?

Soln Assume $X \to Y$ is extra FD (R.F.D)

Procedure forget that $[X \to Y]$ R.F.D (Hide $X \to Y$ FD) &

takes a closure of $(X)^+$ in all other Remaining FD

if $(X)^+ = [\ldots Y]$ then $X \to Y$ is R.F.D (Extra FD).

(a) ~~(1) $A \to B$~~ ~~(2) $B \to C$~~ (3) $A \to C$ → so → $A \to C$ is RFD.

$(A)^+ = [AC]$ $(B)^+ = [B]$ $[A]^+ = [AB\subseteq]$

Example3:

$[B \rightarrow A,\ D \rightarrow A,\ AB \rightarrow D]$

Example 4:

$[A \rightarrow BC,\ CD \rightarrow E,\ E \rightarrow C,\ D \rightarrow AEH,\ ABH \rightarrow BD,\ DH \rightarrow BC]$

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$Y \rightarrow Z$

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$W \rightarrow X$
$Y \rightarrow V$
$Y \rightarrow Z$

C
$V \rightarrow W$
$V \rightarrow X$
$Y \rightarrow V$
$Y \rightarrow X$
$Y \rightarrow Z$

D
$V \rightarrow W$
$W \rightarrow X$
$Y \rightarrow V$
$Y \rightarrow X$
$Y \rightarrow Z$

Any Doubt ?

THANK YOU!