COMPUTER SCIENCE



Database Management System

FD's & Normalization

Minimal Cover-2

Lecture_06

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Equality between FD Set

Minimal Cover





RDBMS Concept

FD Concept

FD types

Attribute closure [x)+

Key Concept

Super key

Canalidate key

Finding Multiple Candidate key.

Membership set.



Membership Set

X -y is member of FD set F. ill X y logically implied in F Valid FD

Sn-DAKSK



@ cc win enjoying

(b) cc

(c)

(a) Doubt.



Member Ship Set

F= [- - -]

X-y is Manufact of FD Set @ Not?

x > y is o member ill X > y logically Implied in F

[X] = [...-y]

then X -y is Member @ Logically inflied @ Valid FD.

Q.

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

$$A \rightarrow B$$

$$A \rightarrow C$$
 $CD \rightarrow E$
 $CD \rightarrow E$
 $CD \uparrow = [CD \in A]$

$$B \to D$$
 (BC) - [BCP

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

[MCQ: GATE - 2M]

C (CD → AC) Interes

$$BC \rightarrow CD$$

$$A \qquad BD \rightarrow CD$$

$$\mathsf{B} \quad \mathsf{AC} \to \mathsf{BC}$$



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



$$P \rightarrow QR$$

$$RS \rightarrow T$$

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

[MSQ: 2021 - 2M]

- $A PS \rightarrow T$
- $B R \to T$
- $C P \rightarrow R$
- $D PS \to Q$



Equality between Two FD set



All the functional Dependency of G. Should be logically implied by F FD Set.

G Covers all the FD's of F.

All the Functional Dependency's (FD's) of F, Should be logically inflied by G FD Set.

F cover G True False True False

G cover F False True True False

FOG GOF FEG Uncomparable



$$G: [AB \rightarrow CD, AB \rightarrow D, C \rightarrow D]$$

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

F Cover G

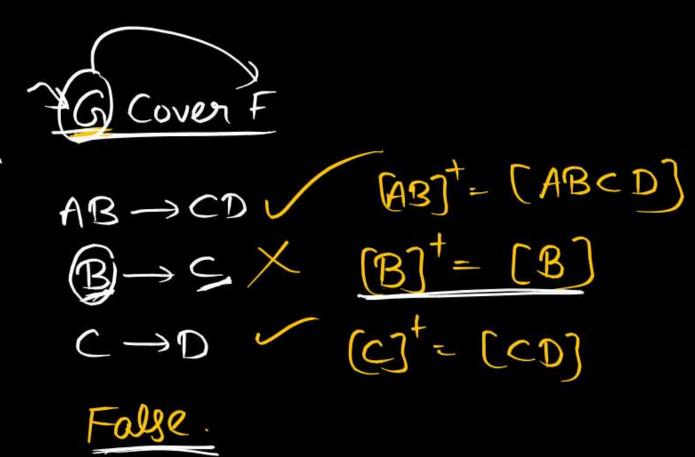
$$AB \rightarrow CD \cdot (AB)^{\dagger} = (ABCD)$$

$$AB \rightarrow D \cdot (AB)^{\dagger} = (ABCD)$$

$$C \rightarrow D \cdot (C)^{\dagger} = (CD)$$

$$True$$





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



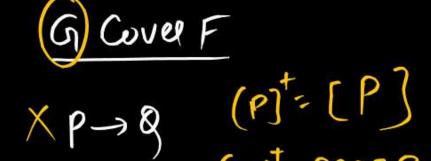
$$F : [P \rightarrow Q, PQ \rightarrow R, PR \rightarrow S, Q \rightarrow R, Q \rightarrow P]$$

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

Which of the following is correct?



F Cover G



ANY (A)
$$PQ \rightarrow S$$
 $(PQ)^{\dagger} = [PQRS]$ $PQ \rightarrow Q$ $(PP)^{\dagger} = [PRSQ]$ $PQ \rightarrow Q$

F and G are equivalent
$$(a) + (a) +$$

(PQ) - (PQSR)

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

 $F: [A \xrightarrow{\mathcal{O}} C, AC \xrightarrow{\mathcal{O}} D, E \xrightarrow{\mathcal{O}} AD, E \xrightarrow{\mathcal{O}} H)$

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

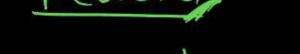
Which of the following is correct?



F Cover G

G Cover F









F and G are equivalent



None of these

$$AC \rightarrow D$$
 $(AC)^{\dagger} - (ACD)$

Mendership.
Lookership Implied

X -> y lookershy Implied

(X)=[.-y]

Minimal cover

The Objective of Minimal Cover is elimination of Redundant FD (RFD)

Redundant FD.: R.F.D @ extra FD is a FD, is we Delete

(R.F.D) that FD then after Deletion does not effect

the Power of FD Set.

(B)F: [A >B, B >c, A >c]

Lets Assume A -> c is Redundant (Extra) FD.

New FD G: [A ->B, B->c]

B) $F: [A \rightarrow B, B \rightarrow C, \underline{A} \rightarrow C]$ original lets Assume $A \rightarrow C$ is RFD; After Deletion of $A \rightarrow C$ from FD set F getty New FD $G: [A \rightarrow B, B \rightarrow C]$

(A) = [AB S] Brom (A) t getting C

So A -> C is R.F.D. Ang

F= [A >B, B > (, A > c]

[F=G]? \ F Cover G: Tove

1) Assume A-)B is R.F.D

G: (B>C, A>C)

FCover G: UB>c (B)= (A): (ARC)

Tre.

G. Cover F

 $A \rightarrow B \times (A)^{\dagger} : (AC)$

B→c

 $A \rightarrow c$

Falge : A >B is Not R.F.D @ Assume B→C is R.F.D

G: [A >B, A >C]

Flower G MA-B (A)t-(MBS)

True

G. Cover F

A-B/(A) = (ABC) XB-CX(B) = (B)

False

: B-C is Not R.F.D

3 Assume A-C is R.F.D

G: [A \B, B \c]

FCOVERG: BYC (B): (BC)

True

Gover FABC)

B>C (B) 1. (BC)

true. (A) = [ABC]

FEG

: A -> c is exton (R.F.D) FD

Minmal: A -> B, B->c.







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

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

[GATE: 2 marks]

F: [AB -c, D-E, AB -E, F-c]

G: [AB+C, D+E, E+C]

F Cover G

We.

G Cover F

Not a Minimal Cover.

(D) . (DEC)

(E) = [EC]

Procedure to bind minimal cover



Split the FD Such that R.H.S (Right hand Side) Contain Single Attribute. Stepl:

(9)
$$X \rightarrow yz \rightarrow X \rightarrow y, X \rightarrow z.$$

Step2: Find the Redundant (Extra) Attribute on L.H.s & Remove from the FD Set.

(a)
$$\overrightarrow{AB}$$
 \longrightarrow C; \overrightarrow{A} is extra is $(B)^{\dagger} = [...A]$ \overrightarrow{B} . Contain A; then Acxtra. B is extra is $(A)^{\dagger} = [...B]$ At Contains B; then Bextra.

B. Contain A; then A extra.

Step 3: Find the Redundant (Extra) FD, & Delete Remove from FD Set F.

(B) A -> B, B->c, A -> C; Here A -> c is Redundant FD 80 Delete/Remove then

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



Procedure to find minimal set

Step (1)

Split the FD such that RHS contain single Attribute.

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

Step (2)

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

Ex.
$$(AB) \rightarrow C$$
,

$$A - Can be deleted [B]^+=[A]$$
 $B^+ Contains 'A'$ OR

B can be delete if
$$A^+$$
 contain 'B' $[A]^+=[...B]$





(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:



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

Stepl: Speit the FD such that R.M.S Contain Single Attroibute.

AB->C, AB->D A>E, E->C

AB->C, AR->D. A-)E, E->C.

Step2: On L.H.s Find Redundant (Extra) Attribute

A is extra is (B) Contain A. AB-c

[A] = [AEC] Not b. B is extra is (A) + Contain B.

So B is Not extra

(B) = (B) Not getting a: 30 1 is Not Extra.

5teb3: Find the Redundant FD & Delete from FD set.

AB-SC BAB-D BA-E B-C [AB] = [ABDEC] [AB] = [ABEC] (AJ! [A] [E]! [E]

Minimal could. AB-1D AJE EAC

Example 2:



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

Step1: R.M.S contain Single Attribute

A>C AC>D, E>A, E>D, E>H

Step2: Bind Redundant Attrobute on L.H.S.

A is extra if (c) Contain A

AC -) D; C is extra is (A) + Contain c.

(A) = [AC...] C is extra Bez (A) contain c

A-C. A-D. F-A, E-D. E-H

Steps: Find the Redundant FD & Delete from FD set

BA-C BA-D GE-A

(A) [E] [EDH] (E) [EACD] (E) [EACD]

AC>D

(C) = (C); A is Not extra BC2 (E)
Not Contain A

ADC ADD EDA EDH Ave

(1) E H

E (A→C, AC→D, E→AD, E→H) G Minimal Cover.

A -> CD: E -> AM

FCover G: Tore (F=G)

(Already Dome in Equality L/w 2 FD Set) How to check Extra FD (Assume A > c) Directly?

(Sor) Hide that FD 4 take closure of LMS of that FD in all the Remaining FD Set (except A > c), if we are getting R.H.S of that FD then we can say (A > c) that FD is Extra FD (R.F.D)

(Note) Minimal Cover May (or) May Not Unique ie we can have More than One Minimal Cover.

Example3:



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



Example 4: $(A \rightarrow BC, CD \rightarrow E, E \rightarrow C, D \rightarrow AEH, ABH \rightarrow BD, DH \rightarrow BC]$



Given the following two statements:



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

Dove voise

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.
- Both S1 and S2 are FALSE.



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]

A
$$V \rightarrow W$$

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

B
$$V \rightarrow W$$

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

$$\begin{array}{c} V \to W \\ V \to X \\ Y \to V \\ Y \to X \\ Y \to Z \end{array}$$

$$\begin{array}{c} D & V \to W \\ W \to X \\ Y \to V \\ Y \to Z \end{array}$$



Consider the following FD Set:



 $\{P \rightarrow QR, Q \rightarrow PR, R \rightarrow PQ\}$ which of the following is/are the minimal cover for the above FD set?



$$P \rightarrow Q, Q \rightarrow R, R \rightarrow P$$



$$P \rightarrow R, Q \rightarrow R, R \rightarrow PQ$$



$$Q \rightarrow P, P \rightarrow R, R \rightarrow Q$$



$$P \rightarrow QR, Q \rightarrow P, R \rightarrow P$$

[Home Work]

Any Doubt ?







