

Non-redundant

$\text{Mo} : \text{O}_2^{\cdot-}$ and

f : given set

3

Minimal Covers

G^+ : minimal set

A minimal cover of a set of functional dependencies (FD) 'F', is a set of FD's 'G', that satisfy the property that every dependency in F is in G^+ . Then G is called minimal.

Steps to find Minimal Set

(1) Split the FDs such that R.H.S. contain single attribute.

E.g. $A \rightarrow B \cup C$  $\Rightarrow A \rightarrow B \quad \text{or} \quad A \rightarrow C$

↳ Right hand side

ii) find the redundant FDs and delete them from the set $\xrightarrow{\text{repeat}}$

E.g.: $\{ A \rightarrow B, B \rightarrow C, \underbrace{A \rightarrow C} \}$ redundant

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

(ii) find the redundant attributes on L.H.S. and delete them

E.g:- $AB \rightarrow C$

(A can be deleted, if B+ Contains A)}

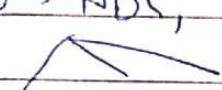
if there was any removal of variables in Step 3
repeat 2.

Example

To find the Minimal Cover.

$\{A \rightarrow B, C \rightarrow B, D \rightarrow ABC, AC \rightarrow D\}$

Step 1: $\{A \rightarrow B, C \rightarrow B, D \rightarrow ABC, AC \rightarrow D\}$

\Rightarrow  (Decompose)

$A \rightarrow B, C \rightarrow B, D \rightarrow A, D \rightarrow B, D \rightarrow C, AC \rightarrow D$

Step 2: Remove Redundant FD's

$A \rightarrow B, C \rightarrow B, D \rightarrow A, \boxed{D \rightarrow B}, D \rightarrow C, AC \rightarrow D$
D redundant

firstly we get the closures

$$A^+ = A$$

$$C^+ = C$$

$$D^+ = DBC$$

$$D^+ = \overbrace{DAB}^{BC}$$

$$D^+ = DAB$$

$$AC^+ = ACB$$

$S_D \rightarrow \{A \rightarrow B, C \rightarrow B, D \rightarrow A, D \rightarrow C, AC \rightarrow D\}$

Step 3:

$A \rightarrow B, C \rightarrow B, D \rightarrow A, D \rightarrow C, AC \rightarrow D$

(we can't reduce) \rightarrow

$AC \rightarrow D$
$C^+ = C$
$A^+ = AB$

Ans: $\{A \rightarrow B, C \rightarrow B, D \rightarrow AC, AC \rightarrow D\}$

Canonical Cover.

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- A canonical cover is a simplified and reduced version of the given set of functional dependencies.
- It is reduced version, it is also called as irreducible set.

Characteristics:-

- It is not unique, it may be more than one cover possible.
- Closure of Canonical cover = initial FD's set closure.
- Canonical Cover is free from all the extraneous FDs.

Extraneous Attribute

An attribute of a functional dependency is said to be extraneous if we can remove it without changing the closure of the set of functional dependencies.

Example

$$R = (A, B, C) \quad FD = \{A \rightarrow BC, A \rightarrow B, AB \rightarrow C\}$$

here $A \rightarrow BC$ $A \rightarrow B$ [so $A \rightarrow B$ extra]
 $A \rightarrow C$ because already there

$AB \rightarrow C$ A is extra [$\frac{A \rightarrow B}{B \rightarrow C} : A \rightarrow C$]
because $B \rightarrow C$ already there

$A \rightarrow BC$: C is extra
by removing C , $A \rightarrow B$

Set $\{A \rightarrow B, B \rightarrow C\}$ all the conditions satisfied.
 \hookrightarrow Canonical Cover's

Example to find Canonical form

$R(w, x, y, z)$

F.O: $\{x \rightarrow w,$
 $wz \rightarrow xy,$
 $y \rightarrow wxz^y\}$

Sol: Step 1 :- (first we will check, if there is any extra attribute for each F.O at R.H.S)

$x \rightarrow w$
 $wz \rightarrow x$
 $wz \rightarrow y$

$y \rightarrow w$

$y \rightarrow x$

$y \rightarrow z$

Now Complete

$$x^+ = \{x, wy\}$$

$$x^+ = x \quad (\text{without using } x \rightarrow w)$$

(So $x \rightarrow w$ is essential.)

$$wz^+ = wzxy$$

$$wz^+ = wzyx \quad (\text{without using } wz \rightarrow x)$$

($wz \rightarrow x$ is not essential)

because FD, wz^+ is same)

$$wz^+ = wz \quad (\text{without using } wz \rightarrow y)$$

it is \downarrow essential.

$$yt^+ = \{y, w, x, z\}$$

$$yt^+ = y, x, z, w \quad (\text{without } y \rightarrow w) \text{ not essential}$$

$$yt^+ = yz \quad (\text{ " } y \rightarrow x) \text{ essential}$$

$$yt^+ = yxw \quad (\text{ " } y \rightarrow z) \text{ essential}$$

All essential FDs

$$x \rightarrow w$$

$$wz \rightarrow y$$

$$y \rightarrow x$$

$$y \rightarrow z$$



Step 2:-

Now we will check if there is any extra attribute at left side of FD.

$$WZ \rightarrow Y$$

Complete

$$WZ^+ = WZYX$$

$$W^+ = W$$

$$Z^+ = Z$$

$WZ \rightarrow Y$ is essential because
 W^+, Z^+ are different.

So:-

$$F_C := \{ X \rightarrow W,$$

$$WZ \rightarrow Y,$$

$$Y \rightarrow X \quad \text{and} \quad Y \rightarrow Z \quad \Rightarrow \quad Y \rightarrow XZ \quad Y \text{ is Canonical Set.}$$

