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Assignment - 4

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1. $E = \{ A \to C,\ AC \to D,\ E \to AD,\ EC \to DH,\ DE \to CH \}$

$F : \{ A \to CD,\ E \to AH \}$

E covers F

$A^+ : \{A, C, D\}$

$E^+ : \{E, A, D, C, H\}$

F covers E

$A^+ : \{A, C, D\}$

$AC^+ : \{A, C, D\}$

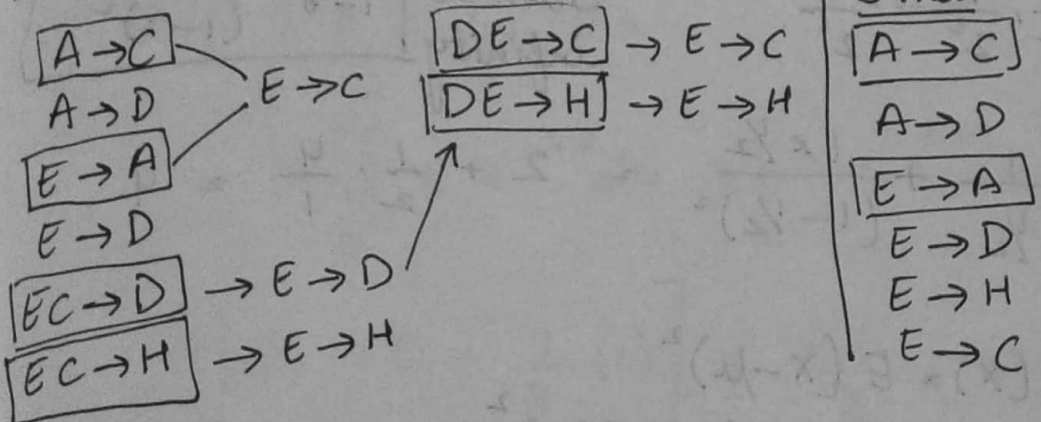
$E^+ : \{E, A, H, C, D\}$

$EC^+ : \{E, A, H, C, D\}$

$DE^+ : \{E, A, H, C, D\}$

Both holds for $F^+ = G^+$, hence they are equivalent.

II. Method Inference Rule:



Minimal Cover

$A \to C$

$A \to D$

$E \to A$

$E \to H$

Final: $R_1(\underline{A}, C, D)$

$R_2(\underline{E}, A, H)$

2) Given a relation R(A,B,C,D,E,F,G,H,I,J)

FD = {AB → C, A → I,
BD → EF, H → J,
AD → GH, GD → ABH}

Canonical form:

AB → C	A → I
BD → E	H → J
BD → F	GD → A
AD → G	GD → B
AD → H	GD → H

∵ AD → G
AD → GD
GD → H
⇒ AD → H is redundant

∴ The minimal cover is:

{AB → C, A → I,
BD → EF, H → J,
AD → G, GD → ABH}

The following is the 3NF decomposition

R1 (A, B, C)	R4 (A, I)
R2 (B, D, E, F)	R5 (H, J)
R3 (A, D, G)	R6 (G, D, A, B, H)

3) Given following set of dependencies:

FD = {AB → CDE, DE → B}
C → BD,
CD → E,

Canonical form:

FD' = {AB → C, C → B, DE → B}
AB → D, C → D
AB → E, CD → E

(i) $AB \to C \Rightarrow AB \to D$ is redundant
$C \to D$

(ii) $AB \to C, \Rightarrow AB \to CD$ $\therefore AB \to E$ is redundant
$AB \to D \quad CD \to E$

(iii) $C \to D \Rightarrow C \to E$
$CD \to E$

(iv) $C \to DE \Rightarrow C \to B$ is redundant
$DE \to B$

$\therefore$ minimal cover of FD is:

$\{AB \to C, \; C \to DE, \; DE \to B\}$

4) Given a relation $R(ABCDEFGHIJ)$

and FDs $F = \{FI \to EHJC, \; F \to EA \quad A \to C\}$
$H \to GB. \quad HI \to FGD$

a) Canonical Form:

$F = \{FI \to E, \; FI \to H, \; FI \to J, \; FI \to C,$
$F \to EA, \; F \to A, \; A \to C, \; H \to G, \; H \to B$
$HI \to F, \; HI \to G, \; HI \to D\}$

(1)
$F \to E$ is redundant

$\because FI \to E \Rightarrow F \to E$ and $I \to E$

(2) $F \to A$

$FI \to A, \; A \to C, \; FI \to C \quad \therefore FI \to C$ is redundant

(3) $H \to G$ and $HI \to G$ are same

$H \to G$ is redundant

∴ minimal cover is.

$F' = \{FI \to HJ,\ H \to BG,\ F \to AE,\ HI \to FD,\ A \to C\}$

Closure:

$\{FI\}^+ = \{F, I, H, J, B, G, A, E, D, C\}$

$\{H^+\} = \{H, G, B\}$

$\{F^+\} = \{F, E, A, C\}$

$\{HI\}^+ = \{H, I, E, D, A, E, B, G, C, J\}$

$\{A\}^+ = \{A, C\}$

$\{FI\}^+$ and $\{HI\}^+$ has all attributes. Thus they are candidate keys.

b) Convert to 3NF:

$F' = \{FI \to E,\ FI \to H,\ FI \to J,\ FI \to C,$
$H \to G,\ H \to B,\ F \to A,\ F \to E,$
$HI \to G,\ HI \to F,\ HI \to D,\ A \to C\}$

minimal cover:

$\{FI \to HJ,\ H \to BG,\ F \to AE,\ HI \to FD,\ A \to C\}$

∴ 3NF = $R_1(\underline{F}, \underline{I}, H, J)$
$R_2(\underline{H}, B, G)$
$R_3(\underline{F}, A, E)$
$R_4(\underline{H}, \underline{I}, F, D)$
$R_5(\underline{A}, C)$

5) Given a relation $R(E, F, G, H, I)$

with a FD. $F = \{FG \to E,\ HI \to E,\ F \to G,\ FE \to H,\ H \to I\}$

Minimal cover with closure:

(i) $\{F\}^+ = \{F, G, E, H, I,\}$

$\because F \to G,\ FG \to E \Rightarrow F \to E$

(ii) $HE \to E$

$\{H\}^+ = \{H, I, E\}$

(iii) $\{F\}^+ = \{F, G, E, H, I, E\}$

$\because FE \to H \Rightarrow F \to H$

The new FD's are:

$\{F \to k,\ H \to k, F \to G,\ F \to H,\ H \to I\}$

Removing redundancy:

(i) $F \to H, H \to E \Rightarrow F \to E$

$\therefore F \to E$ is redunant.

$\therefore$ minimal cova is $\{H \to E,\ F \to G,\ F \to H,\ H \to I\}$

$\{H \to EI,\ F \to GH\}$

3NF - form:

$R_1(\underline{F}, G, H)$, $R_2(\underline{H}, I, F)$

6) Given a relation R(A, B, C, D, E, F, G, H, I, J)
and FD F = {DG → CFHB, F → EA, FG → DEJ
D → CJB, J → B

a) Canonical Form:

F' = {DG → C, F → E, FG → I
DG → F, F → A, D → C
DG → H, FG → D, D → J
DG → B, FG → E, J → B}

(i) DG → B is redunant

D → J, J → B ⇒ D → B

(ii) DG → C is redundant

D → C and DG → C

(iii) FG → E is redundant

FG → E and F → E

minimal cover:

F = {DG → FH, D → CJ, F → EA, J → B, FG → D}

closure:

{DG}⁺ = {D, G, F, H, C, I, E, A, B, I}

{D}⁺ = {D, C, J, B}

{F}⁺ = {F, E, A}

{J}⁺ = {J, D}

{FG}⁺ = {F, G, D, I, H, C, J, B, E, A}

$\{DG\}^+$, $\{FG\}^+$ include all attributes they both are candidate keys:

∴ prime attributes are: $\{D, F, G\}$

(6) (1) partial-dependency: $F \to EA$

(2) non prime to non-prime: $J \to B$

minimal cover:

$\{DG \to FH,\ F \to EA,\ D \to GJ,\ FG \to DI,\ J \to B\}$

∴ for 3NF:

$R_1(\underline{D}, \underline{G}, F, H)$ $R_4(\underline{F}, \underline{G}, D, \underline{I})$

$R_2(\underline{F}, E, A)$ $R_5(\underline{J}, B)$

$R_3(\underline{D}, C, \underline{I})$

7) Given Relation $R(C, D, E, F, G)$

with FD $F = \{F \to G,\ D \to E,\ DC \to F,$

$DE \to C,\ FG \to C\}$

As we can see F is already in standard canonical form.

Closure:

$\{F\}^+ = \{F, G, C\}$

$\{D\}^+ = \{D, E, C, F, G\}$

∴ $DE \to C$, remove E and

$DC \to F$, remove C

∴ $DC \to F \Rightarrow D \to F$

$DE \to C \Rightarrow D \to C$

∴ new FD F' is,

$F' = \{F \to G, D \to E, D \to F, D \to C, F \to C\}$

Removing Redundancies:

(i) $D \to F, F \to C \Rightarrow D \to C$

∴ $D \to C$ is redundant

∴ minimal cover = $\{F \to G, D \to E, D \to F, F \to C\}$

3NF:

$R_1(\underline{F}, \underline{G}, C)$, $R_2(D, E, F)$