ASSIGNMENT 4

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

If E covers F and F covers E then E and F are equivalent.

E covers F:

$A^+ = \{A, C, D\}$
$E^+ = \{E, A, D, C, H\}$
$A \to CD$ and $E \to AH$ are satisfied
Hence E covers F

F covers E:

$A^+ = \{A, C, D\}$
$AC^+ = \{A, C, D\}$
$E^+ = \{E, A, H, C, D\}$
$EC^+ = \{E, C, A, H, D\}$
$DE^+ = \{D, E, A, H, C, D\}$
$A \to C,\ AC \to D,\ E \to AD,\ EC \to DH,\ DE \to CH$ are satisfied
Hence F covers E

Since E covers F and F covers E, E and F are equivalent.

2. $R(A, BCDEFGHIJ)$

$AB \to C$, $BD \to EF$, $AD \to GH$, $A \to I$, $H \to J$, $GD \to ABH$

Find candidate keys:

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

$H^+ = \{H, J\}$

$AB^+ = \{A, B, C, I\}$

$BD^+ = \{B, D, E, F\}$

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

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

AD and GD are candidate keys.

Choosing GD as primary key

R is in 2NF because there are no partial dependencies.

R is not in 3NF because of $A \to I$, $H \to J$, $AB \to C$

Normalizing into 3NF

$R1(\underline{A}, \underline{B}, C)$ $R2(\underline{A}, I)$ $R3(\underline{H}, J)$

$R(\underline{G}, \underline{D}, A, B, H, E, F)$

3. Find minimal cover of following dependencies
$\{AB \rightarrow CDE, C \rightarrow BD, CD \rightarrow E, DE \rightarrow B\}$

Ans:-

$AB \rightarrow C$
$AB \rightarrow D$
$AB \rightarrow E$
$C \rightarrow B$
$C \rightarrow D$
$CD \rightarrow E$
$DE \rightarrow B$

$AB \rightarrow C$ and $C \rightarrow D$ gives $AB \rightarrow D$
Hence $AB \rightarrow D$ is redundant.

From $C \rightarrow D$ and $CD \rightarrow E$ we can deduce $C \rightarrow E$

$AB \rightarrow C$ and $C \rightarrow E$ (from above step) gives $AB \rightarrow E$
So $AB \rightarrow E$ is redundant

from $C \rightarrow D$, $C \rightarrow E$, $DE \rightarrow B$ we have $C \rightarrow B$
So $C \rightarrow B$ is redundant

Minimal cover = $\{AB \rightarrow C, C \rightarrow DE, DE \rightarrow B\}$

4. R(A, B, C, D, E, F, G, H, I, J)

FI → EHJC H → GB F → EA HI → FGD A → C

a) Find candidate keys:

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

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

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

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

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

Since FI and HI covers every other attribute the candidate keys are FI and HI

Prime attributes of R = {F, H, I}

b) R is not in 2NF. Hence decomposing will give

R1 (<u>F</u>, E, A, **C**) R2 ([illegible], B, [illegible], D, E, G, H, <u>I</u>, J, <u>**F**</u>) {Choosing FI as candidate key}

R1 and R2 are not in 3NF because of

H → GB and A → C

So normalizing into 3NF will give

R11 (<u>A</u>, C)

R12 (<u>F</u>, E, A)

R21 (<u>F</u>, <u>I</u>, H, J, D)

R22 (<u>H</u>, G, B)

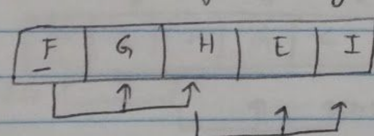
FI is choosen as the candidate key.

5. Given functional dependencies:
$FG \rightarrow E \quad HI \rightarrow E \quad F \rightarrow G \quad FE \rightarrow H \quad H \rightarrow I$

From $H \rightarrow I$ and $HI \rightarrow E$ we get $H \rightarrow E$ from $HI \rightarrow E$
From $F \rightarrow G$ and $FG \rightarrow E$ we get $F \rightarrow E$ from $FG \rightarrow E$
We get $F \rightarrow H$ from $FE \rightarrow H$ since $F \rightarrow E$ and $FE \rightarrow H$
From $F \rightarrow H$ and $H \rightarrow E$ we can eliminate $F \rightarrow E$

So we are left with $H \rightarrow E$, $H \rightarrow I$, $F \rightarrow G$, $F \rightarrow H$
Hence minimal cover $= \{H \rightarrow EI,\ F \rightarrow GH\}$

$H^+ = \{E, I, H\} \qquad F^+ = \{F, G, H, E, I\}$
So F is the primary key



It is in 2NF and not in 3NF
So decomposing into 3NF will give two relations:

R1 (<u>F</u>, G, H) R2 (<u>H</u>, E, I)

6. R(ABCDEFGHIJ)

$DG \to CFHB \quad D \to CJ \quad F \to EA \quad J \to B \quad FG \to DEI$

a)

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

$D^+ = \{D, C, J, B\}$

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

$J^+ = \{J, B$

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

~~a)~~ So candidate keys are DG and FG

Prime attributes of R = D, F, G

b) Choosing DG as candidate key

R is not in 2NF because of $D \to CJ$ (partial dependency)

R1 ($\underline{D}$, C, J, B) R2 ($\underline{D}$, $\underline{G}$, F, H, E, I, A)

The above relation is not in 3NF because of $F \to EA$ in R2 and $J \to B$ in R1

Normalizing to 3NF gives

R21 ($\underline{D}$, $\underline{G}$, F, H, I)

R22 ($\underline{F}$, E, A)

R11 ($\underline{D}$, C, J)

R12 ($\underline{J}$, B)

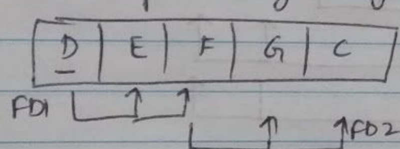
7. R(CDEFG)

$F \to G \quad D \to E \quad DC \to F \quad DE \to C \quad FG \to C$

From $F \to G$ and $FG \to C$, $FG \to C$ reduces to $F \to C$
from $D \to E$ and $DE \to C$, $DE \to C$ becomes $D \to C$
From $D \to C$ (above step) and $DC \to F$, $DC \to F$ changes to $D \to F$
From $D \to F$ and $F \to C$, $D \to C$ becomes redundant

So ~~relations~~ we are left with $F \to G$, $D \to E$, $D \to F$, $F \to C$
Minimal cover of R : $\{F \to GC,\ D \to EF\}$

$F^+ = \{F, G, C\} \quad D^+ = \{D, E, F, G, C\}$
D is the primary key



It is in 2NF and not in 3NF (FD2 violates 3NF)
Decomposing will give

R1 (<u>D</u>, E, F) R2 (<u>F</u>, G, C)