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In-class Exercise 05 Schema Refinement

Q1. Please calculate A^+ , G^+ and AG^+ given $F = \{A \rightarrow B, A \rightarrow C, CG \rightarrow H, CG \rightarrow I, B \rightarrow H\}$ and $R = (A, B, C, G, H, I)$. What is the key of R?

$$\begin{aligned} A^+ &= \{A, B, C, H\} \\ G^+ &= \{G\} \\ AG^+ &= \{A, B, C, G, H\} \end{aligned}$$

$$\{AG\}$$

Q2. Given $R = (A, B, C)$ and $F = \{A \rightarrow B, C \rightarrow B\}$, what is the key for R? Is R in BCNF? Why?

$$\begin{aligned} A^+ &= \{A, B\} & C^+ &= \{B\} \\ B^+ &= \{B\} & AC^+ &= \{ABC\} \quad \therefore \{AC\} \end{aligned}$$

R isn't BCNF

A isn't the key in $A \rightarrow B$

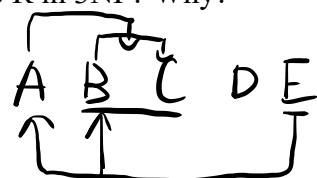
C isn't the key in $C \rightarrow B$

Q3. Given a schema $R = (A, B, C, D, E)$ and functional dependencies $F = \{E \rightarrow A, E \rightarrow B, A \rightarrow BC, B \rightarrow C\}$. What is the key of R? Is R in 3NF? Why?

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

$$ED^+ = \{ABCDE\}$$

$$\therefore \{ED\}$$



No. 3NF $B \rightarrow C$ is wrong

$B \rightarrow C$ is not trivial

B is not a key and C is not in the key

Q4. Given $R = \{A, B, C, D, E\}$ and $F = \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$.
(1) $R_1 = \{A, B, C\}$, $R_2 = \{A, D, E\}$. Is (1) a lossless join decomposition? Why?

Yes, It's a lossless join decomposition

Because the common part of R_1 and R_2 , $A \rightarrow ABC \in F^+$

(2) $R_1 = \{A, B, C\}$, $R_2 = \{C, D, E\}$. Is (2) a lossless join decomposition? Why?

No

C can't determine R_1 and R_2

Q5. Given $R = \{A, B, C, D, E\}$ $F = \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$, we have the following decomposition:

$$R_1 = \{A, B, C\}, R_2 = \{A, D, E\}.$$

Is the above decomposition dependency-preserving? Why?

$$\begin{array}{ll} F_1 = \{A \rightarrow BC\} & CD \rightarrow E \text{ and } B \rightarrow D \\ F_2 = \{E \rightarrow A\} & \text{isn't in } (F_1 \cup F_2)^+ \end{array}$$

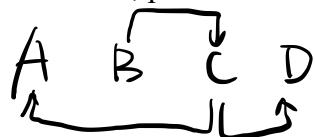
\therefore isn't the decomposition dependency

Q6. Given $R = \{A, B, C, D\}$ and $F = \{C \rightarrow D, C \rightarrow A, B \rightarrow C\}$.

(1) Identify all candidate keys for R .

$$\{B\}$$

(2) Is R in BCNF? If not, please decompose R into BCNF.



No BCNF, $C \rightarrow D, C \rightarrow A$
violated

First, take $C \rightarrow D$: decompose R to $R_1 = \{A, B, C\}$, $R_2 = \{D\}$
since R_1 violates BCNF $\because R_{11} = \{B, C\}$ $R_{12} = \{A\}$

Final: $R_2 = \{C, D\}$ $R_{11} = \{B, C\}$ $R_{12} = \{A\}$

Q7. R = (A, B, C, D, E) and F = {AC → E, ACD → B, CE → D, B → E}. Please give the canonical cover of F.

$$AC \rightarrow E, ACD \rightarrow B, CE \rightarrow D, B \rightarrow E$$

$$AC \rightarrow E, AC \rightarrow B, CE \rightarrow D, B \rightarrow E$$

$$AC \rightarrow BE, CE \rightarrow D, B \rightarrow E$$

$$AC \rightarrow B, CE \rightarrow D, B \rightarrow E$$

$AC \rightarrow CG$ $CH \rightarrow BD$

Q8. R = (A, B, C, D, E, F, G, H) and F = {AC → G, D → EG, BC → D, CG → BD, ACD → B, CE → AG}. What is the canonical cover of F? Please decompose R into 3NF.

$$\{AC \rightarrow B, D \rightarrow EG, BC \rightarrow D, CG \rightarrow BD, ACD \rightarrow B, CE \rightarrow AG\}$$

$$CK = \{CE\}$$

$$T_1(A, B, C)$$

$$T_2(D, E, G)$$

$$T_3(B, C, D)$$

$$T_4(C, D, G)$$

$$T_5(A, C, E)$$