Normalization: Practice Problems

Dr. Shrutilipi Bhattacharjee, Assistant Professor, Dept. of IT, NIT Karnataka, India

Practice Problem on Functional Dependencies

- Find if a given functional dependency is implied from a set of functional dependencies:
  - For: $A \rightarrow BC$, $CD \rightarrow E$, $E \rightarrow C$, $D \rightarrow AEH$, $ABH \rightarrow BD$, $DH \rightarrow BC$
    - Check: $BCD \rightarrow H$
    - Check: $AED \rightarrow C$
  - For: $AB \rightarrow CD$, $AF \rightarrow D$, $DE \rightarrow F$, $C \rightarrow G$, $F \rightarrow E$, $G \rightarrow A$
    - Check: $CF \rightarrow DF$
    - Check: $BG \rightarrow E$
    - Check: $AF \rightarrow G$
    - Check: $AB \rightarrow EF$
  - For: $A \rightarrow BC$, $B \rightarrow E$, $CD \rightarrow EF$
    - Check: $AD \rightarrow F$

Practice Problem on Functional Dependencies

- Find candidate key using functional dependencies:
  - **R** = (ABCDE); FDs = {$AB \rightarrow C$, $DE \rightarrow B$, $CD \rightarrow E$}
  - **R** = (ABCDE); FDs = {$AB \rightarrow C$, $C \rightarrow D$, $B \rightarrow AE$}

- Find superkey using functional dependencies:
  - **R** = (ABCDE); FDs = {$AB \rightarrow C$, $DE \rightarrow B$, $CD \rightarrow E$}
  - **R** = (ABCDE); FDs = {$AB \rightarrow C$, $C \rightarrow D$, $B \rightarrow AE$}

Practice Problem on Functional Dependencies

- Find prime and nonprime attributes using functional dependencies:
  - **R** = (ABCDEF); FDs = {$AB \to C$, $C \to D$, $D \to E$, $F \to B$, $E \to F$}
  - **R** = (ABCDEF); FDs = {$AB \to C$, $C \to DE$, $E \to F$, $C \to B$}
  - **R** = (ABCDEFGHIJ); FDs = {$AB \to C$, $A \to DE$, $B \to F$, $F \to GH$, $D \to IJ$}
  - **R** = (ABDLPT); FDs = {$B \to PT$, $A \to D$, $T \to L$}
  - **R** = (ABCDEFGH); FDs = {$E \to G$, $AB \to C$, $AC \to B$, $AD \to E$, $B \to D$, $BC \to A$}
  - **R** = (ABCDE); FDs = {$A \to BC$, $CD \to E$, $B \to D$, $E \to A$}
  - **R** = (ABCDEH); FDs = {$A \to B$, $BC \to D$, $E \to C$, $D \to A$}

- **Prime attributes:** Attribute set that belongs to any candidate key are called *prime attributes*
  - It is union of all the candidate key attribute: {CK1 ∪ CK2 ∪ CK3 ∪ …}
  - If prime attribute determined by other attribute set, then more than one candidate key is possible
  - For example, if A is candidate key, and $A \to B$, then, X is also candidate key
- **Nonprime attributes:** Attribute set that does not belongs to any candidate key are called *nonprime attributes*

Practice Problem on Functional Dependencies

- Check the equivalence of a pair of sets of functional dependencies:
  - Consider the two sets F and G with their FDs as below:
    - F : $\{A \rightarrow C, AC \rightarrow D, E \rightarrow AD, E \rightarrow H\}$
    - G : $\{A \rightarrow CD, E \rightarrow AH\}$
  - Consider the two sets P and Q with their FDs as below:
    - P : $\{A \rightarrow B, AB \rightarrow C, D \rightarrow ACE\}$
    - Q : $\{A \rightarrow BC, D \rightarrow AE\}$

Practice Problem on Functional Dependencies

- Find the minimal cover or irreducible sets or canonical cover of a set of functional dependencies:
  - $AB \rightarrow CD$, $BC \rightarrow D$
  - $ABCD \rightarrow E$, $E \rightarrow D$, $AC \rightarrow D$, $A \rightarrow B$

Practice Problem on Lossless Join

- Check if the decomposition of **R** into **D** is lossless:
  - **R** = (ABC); FDs = {$A \rightarrow B$, $A \rightarrow C$}; D = $\mathbf{R_1}$(AB), $\mathbf{R}_2$(BC);
  - **R** = (ABCDEF); FDs = {$A \rightarrow B$, $B \rightarrow C$, $C \rightarrow D$, $E \rightarrow F$}; D = $\mathbf{R_1}$(AB), $\mathbf{R}_2$(BCD); $\mathbf{R}_3$(DEF);
  - **R** = (ABCDEF); FDs = {$A \rightarrow B$, $C \rightarrow DE$, $AC \rightarrow F$}; D = $\mathbf{R_1}$(BE), $\mathbf{R}_2$(ACDEF);
  - **R** = (ABCDEG); FDs = {$AB \rightarrow C$, $AC \rightarrow B$, $AD \rightarrow E$, $B \rightarrow D$, $BC \rightarrow A$, $E \rightarrow G$}; D = $\mathbf{R_1}$(AB), $\mathbf{R}_2$(BC), $\mathbf{R_3}$(ABDE), $\mathbf{R}_4$(EG);
  - **R** = (ABCDEG); FDs = {$AB \rightarrow C$, $AC \rightarrow B$, $AD \rightarrow E$, $B \rightarrow D$, $BC \rightarrow A$, $E \rightarrow G$}; D = $\mathbf{R_1}$(ABC), $\mathbf{R}_2$(ACDE), $\mathbf{R_3}$(ADG);
  - **R** = (ABCDEFGHIJ); FDs = {$AB \rightarrow C$, $B \rightarrow F$, $D \rightarrow IJ$, $A \rightarrow DE$, $F \rightarrow GH$}; D = $\mathbf{R_1}$(ABC) , $\mathbf{R}_2$(ADE), $\mathbf{R_3}$(BF), $\mathbf{R}_4$(FGH), $\mathbf{R_5}$(DIJ);
  - **R** = (ABCDEFGHIJ); FDs = {$AB \rightarrow C$, $B \rightarrow F$, $D \rightarrow IJ$, $A \rightarrow DE$, $F \rightarrow GH$}; D = $\mathbf{R_1}$(ABCDE) , $\mathbf{R}_2$(BFGH), $\mathbf{R_3}$(DIJ);
  - **R** = (ABCDEFGHIJ); FDs = {$AB \rightarrow C$, $B \rightarrow F$, $D \rightarrow IJ$, $A \rightarrow DE$, $F \rightarrow GH$}; D = $\mathbf{R_1}$(ABCD) , $\mathbf{R}_2$(DE), $\mathbf{R_3}$(BF), $\mathbf{R}_4$(FGH), $\mathbf{R_5}$(DIJ);

Practice Problem for 3NF Decomposition

- **R** = (ABCDEFGH); FDs = {$A \rightarrow B$, $ABCD \rightarrow E$, $EF \rightarrow GH$, $ACDF \rightarrow EG$}
- **R** = (CSJDPQV); FDs = {$C \rightarrow CSJDPQV$, $SD \rightarrow P$, $JP \rightarrow C$, $J \rightarrow S$}
- **R** = (ABCDEFGH); FDs = {$A \rightarrow CD$, $ACF \rightarrow G$, $AD \rightarrow BEF$, $BCG \rightarrow D$, $CF \rightarrow AH$, $CH \rightarrow G$, $D \rightarrow B$, $H \rightarrow DEG$}
- **R** = (ABCDE); FDs = { A→B, AB→D, B→BDE, C→D, D→D }
- **R =** (BOISQD); FDs = {I→B, IS→Q, B→O, S→D}
- **R** = (ABCDE); FDs = { A→CD, B→CE, E→B}

Practice Problem for BCNF Decomposition

- **R** = (ABCDE); FDs = {$A \rightarrow B$, $BC \rightarrow D$}
- **R** = (ABCDEH); FDs = {$A \rightarrow BC$, $E \rightarrow HA$}
- **R** = (CSJDPQV); FDs = {$C \rightarrow CSJDPQV$, $SD \rightarrow P$, $JP \rightarrow C$, $J \rightarrow S$}
- **R** = (ABCD); FDs = {$C \rightarrow D$, $C \rightarrow A$, $B \rightarrow C$}

Thank you...

Any question?

Contact:
Department of Information Technology, NITK Surathkal, India
6^{th} Floor, Room: 13
Phone: +91-9477678768
E-mail: shrutilipi@nitk.edu.in