Exercises, Part 2

Exercise

Suppose that we have the following three tuples in an instance of $S(ABC)$: $(1, 2, 3)$, $(4, 2, 3)$, and $(5, 3, 3)$. Which of of the following dependencies do not hold

1. $B \rightarrow A$
2. $BC \rightarrow A$
3. $B \rightarrow C$

Can you identify any dependencies that hold on S?

Solution

1. No
2. No
3. Yes

$A \to B$

Exercise

For $R(ABCD)$ with the following dependencies, identify the potential keys and decompose into BCNF (if it is not already in BCNF)

1. $C \to D$, $C \to A$, $B \to C$
2. $B \to C$, $D \to A$
3. $ABC \to D$, $D \to A$
4. $A \to B$, $BC \to D$, $A \to C$
5. $AB \to C$, $AB \to D$, $C \to A$, $D \to B$

Solution

1. 1. Candidate keys: B
   2. BCNF violations: $C \to D$ and $C \to A$
   3. Decomposition: AC, BC, and CD
2. 1. Candidate key: BD
   2. BCNF violations: $B \to C$ and $D \to A$
   3. Decomposition: AD, BC, BD
3. 1. Candidate keys: ABC, BCD
   2. BCNF violation $D \to A$. Decomposition: AD, BCD
4. 1. Candidate key: A
   2. Decomposition BCD, ABC
5. 1. Candidate keys: AB, BC, CD, AD
   2. BCNF violations $C \to A$ and $D \to B$ Decomposition AC, BD, CD.

Exercise

Consider the attributes $R = ABCDEGH$ and the FDs $AB \to C$, $AC \to B$, $AD \to E$, $B \to D$, $BC \to A$, and $E \to G$

For each of the following attribute sets, find the dependencies that hold over them and decompose into BCNF

1. ABC
2. $ABCD$
3. $ABCEG$
4. $DCEGH$
5. $ACEH$

Solution

1. $AB \to C$, $AC \to B$, $BC \to A$

   BCNF decomposition: ABC

2. $AB \to CD$, $AC \to BD$, $BC \to AD$

   BCNF decomposition: $ABCD$

3. $AB \to CEG$, $AC \to BEG$, $BC \to AEG$, $E \to G$

   BCNF decomposition: $ABCE$, EG

4. $E \to G$,

   BCNF: $CDEH$, EG

5. $AC \to E$

   BCNF: ACE, ACH

Are the following schemas in BCNF? If not, decompose them into BCNF.

1. $R(A, B, C, D)$ with $AB \to C$, $C \to D$ and $D \to A$
2. $R(A, B, C, D)$ with $B \to C$ and $B \to D$
3. $R(A, B, C, D)$ with $AB \to C$, $BC \to D$, $CD \to A$, and $AD \to B$
4. $R(A, B, C, D)$ with $A \to B$, $B \to C$, $C \to D$, and $D \to A$
5. $R(A, B, C, D, E)$ with $AB \to C$, $DE \to C$, and $B \to D$
6. $R(A, B, C, D, E)$ with $AB \to C$, $C \to D$, $D \to B$, and $D \to E$
7. $R(B, O, S, Q, I, D)$ with $S \to D$, $I \to B$, $IS \to Q$, and $B \to O$

Solution

1. ABC, CD then AC, BC, CD
2. BC, BD, AB
3. In BCNF
4. In BCNF
5. ABC, BD, ABE
6. DE, CD, BC, AC
7. SD, BO, BI, SQI