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Homework #2

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# 1 Question #1

Suppose we have relation  $R(A, B, C, D, E)$  with some set of FD's, and we wish to project those FD's onto relation  $S(A, B, C)$ . Give the FD's that hold in  $S$  if the FD's for  $R$  are:

- a)  $AB \rightarrow DE, C \rightarrow E, D \rightarrow C$  and  $E \rightarrow A$ .
- b)  $A \rightarrow D, BD \rightarrow E, AC \rightarrow E$  and  $DE \rightarrow B$ .
- c)  $AB \rightarrow D, AC \rightarrow E, BC \rightarrow D, D \rightarrow A$  and  $E \rightarrow B$ .
- d)  $A \rightarrow B, B \rightarrow C, C \rightarrow D, D \rightarrow E$  and  $E \rightarrow A$ .

Solution:

- a) All FD's in  $R(A, B, C, D, E)$ :  $AB \rightarrow CDE, C \rightarrow AE, D \rightarrow ACE, E \rightarrow A$ .

**Solution:** All FD's in  $S(A, B, C)$ :  $AB \rightarrow C, C \rightarrow A$

- b) All FD's in  $R(A, B, C, D, E)$ :  $A \rightarrow D, BD \rightarrow E, AC \rightarrow BE, DE \rightarrow B, AE \rightarrow B, AB \rightarrow E$ .

**Solution:** All FD's in  $S(A, B, C)$ :  $AC \rightarrow B$

- c) All FD's in  $R(A, B, C, D, E)$ :  $AB \rightarrow D, AC \rightarrow BDE, BC \rightarrow ADE, D \rightarrow A, E \rightarrow B$ .

**Solution:** All FD's in  $S(A, B, C)$ :  $AC \rightarrow B, BC \rightarrow A$ .

- d) All FD's in  $R(A, B, C, D, E)$ :  $A \rightarrow BCDE, B \rightarrow ACDE, C \rightarrow ABDE, D \rightarrow ABCE, E \rightarrow ABCD$ .

**Solution:** All FD's in  $S(A, B, C)$ :  $A \rightarrow BC, B \rightarrow AC, C \rightarrow AB$

## 2 Question #2

For each of the following relation schemas and dependencies:

- a)  $R(A, B, C, D)$  with MVD  $AB \twoheadrightarrow C$  and FD  $B \rightarrow D$ .
- b)  $R(A, B, C, D, E)$  with MVD's  $AB \twoheadrightarrow B, AB \twoheadrightarrow C$  and FD's  $A \rightarrow D, AB \rightarrow E$ .

do the following:

- i) Find all the 4NF violations.
- ii) Decompose the relations into a collection of relation schemas in 4NF.

**Solution for (i):**

- a)  $R(A, B, C, D)$  with MVD  $AB \twoheadrightarrow C$  and FD  $B \rightarrow D$ :  
Key =  $\{ABC\}$ , **Violations:**  $AB \twoheadrightarrow C, B \twoheadrightarrow D$
- b)  $R(A, B, C, D, E)$  with MVD's  $AB \twoheadrightarrow B, AB \twoheadrightarrow C$  and FD's  $A \rightarrow D, AB \rightarrow E$ :  
Key =  $\{ABC\}$ , **Violations:**  $AB \twoheadrightarrow C, A \twoheadrightarrow D, AB \twoheadrightarrow E$

**Solution for (ii):**

- a)  $R(A, B, C, D)$  with MVD  $AB \twoheadrightarrow C$  and FD  $B \rightarrow D$ :  
Key =  $\{ABC\}$   
Choose the violation  $AB \twoheadrightarrow C$   
 $R_1 = \{ABC\}$   
 $R_2 = \{ABD\}$

Decompose  $R_2(A, B, D)$  with FD  $B \rightarrow D$

Key =  $\{AB\}$

Choose the violation  $B \twoheadrightarrow D$

$R_3 = \{BD\}$

$R_4 = \{AB\}$

**So the relational schemas are:**

$R_1(A, B, C)$  with MVD  $AB \twoheadrightarrow C$

$R_3(B, D)$  with FD  $B \rightarrow D$

$R_4(A, B)$

b)  $R(A, B, C, D, E)$  with MVD's  $AB \twoheadrightarrow B, AB \twoheadrightarrow C$  and FD's  $A \rightarrow D, AB \rightarrow E$ .

Key =  $\{ABC\}$

Choose violation  $AB \twoheadrightarrow C$

$R_1 = \{ABC\}$

$R_2 = \{ABDE\}$

Decompose  $R_2(A, B, D, E)$  with MVD  $AB \twoheadrightarrow B$  and FD's  $A \rightarrow D, AB \rightarrow E$ .

Key =  $\{AB\}$

Choose Violation  $A \twoheadrightarrow D$

$R_3 = \{AD\}$   $R_4 = \{ABE\}$

**So the relational schemas are:**

$R_1(A, B, C)$  with MVD's  $AB \twoheadrightarrow B, AB \twoheadrightarrow C$ .

$R_3(A, D)$  with FD  $A \rightarrow D$

$R_4(A, B, E)$  with MVD  $AB \twoheadrightarrow B$  and FD  $AB \rightarrow E$