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CS 775/875

HW 9

1. Consider the universal relation $R = \{a, b, c, d, E\}$ and the set of functional dependencies $FD = \{\{a\} \rightarrow \{b, c\}, \{b\} \rightarrow \{d\}\}$ and MVD $= \{\{b\} \twoheadrightarrow \{c, d\}\}$

1. (1) Write all the candidate keys for R.

$(AE)^+$ $(ABE)^+$ $(ADE)^+$ $(ABDE)^+$
 $(ACE)^+$ $(ABCE)^+$ $(ABDE)^+$

2. (6) What schema(s) would be produced by the 4NF decomposition algorithm?

A. $R1(a,d)$, $R2(b,c)$, $R3(a,b)$, $R4(a,E)$

B. $R1(b,d)$, $R2(b,c)$, $R3(a,b)$, $R4(a,E)$

☒ C. both options are correct

D. both options are wrong

2. Consider the universal relation $R = \{a, b, c, d, E\}$ and the set of functional dependencies $FD = \{\{a, b\} \rightarrow \{E\}, \{a\} \rightarrow \{d\}\}$ and the set of MVDs $= \{\{a\} \twoheadrightarrow \{b\}, \{a, b\} \twoheadrightarrow \{c\}\}$.

1. (1) Write all the candidate keys for R.

$(a, b, c)^+$ $(a, b, c, E)^+$ $(a, b, c, d)^+$

2. (4) What schema(s) would be produced by the 4NF decomposition algorithm?

- ☒ A. $R_1 = \{a, b\}$, $R_2 = \{a, d\}$, $R_3 = \{a, c, E\}$
B. $R_1 = \{a, b\}$, $R_2 = \{a, E\}$, $R_3 = \{a, c\}$, $R_4 = \{a, d\}$
C. $R_1 = \{a, b\}$, $R_2 = \{a, d, E\}$, $R_3 = \{a, c\}$
☒ D. $R_1 = \{a, b, E\}$, $R_2 = \{a, b\}$, $R_3 = \{a, c\}$, $R_4 = \{a, d\}$

3. Consider the universal relation $R = \{a, b, c, d, E\}$ and the set of functional dependencies $FD = \{\{a\} \rightarrow \{b\}, \{b\} \rightarrow \{ce\}\}$ and the set of MVDs $= \{\{b\} \twoheadrightarrow \{d\}\}$.

1. (1) Write all the candidate keys for R.

$$(AD)^+ \quad (A, B, D)^+ \quad (A, C, D)^+ \quad (A, B, E)^+ \\ (A, B, C, D)^+ \quad (A, B, D, E)^+ \quad (A, C, D, E)^+$$

2. (3) Decompose the relation R into 4NF relations.

$$R1 = \{a, b\} \quad R2 = \{a, c, e\} \quad R3 = \{a, d\}$$

$$R1 = \{a, d\} \quad R2 = \{a, b\} \quad R3 = \{a, c, e\} \quad R4 = \{b, d\}$$

A	B	C	D
a1	b1	c1	d1
a1	b2	c1	d1
a1	b2	c2	d2
a1	b1	c2	d2
a2	b3	c1	d2

1. (4) Does the above table have a non-trivial MVD that is not a FD? If so, identify the MVD. You just have to identify one MVD.

$A \twoheadrightarrow C$

2. (2) Identify one candidate key.

$(BD)^+$

4.

A	B	C	D
a1	b1	c1	d1
a1	b1	c2	d2
a1	b2	c1	d1
a1	b3	c2	d2
a2	b2	c1	d1

$B \rightarrow A$

1. (3) What functional dependencies would be satisfied by inserting the tuples (a1,b1,c2,d1) and (a1,b1,c1,d2) in the table:
 - A. $A \rightarrow B$
 - ☒ B. $A \rightarrow D$
 - C. $B \rightarrow A$
 - ☐ D. $B \rightarrow D$
 - E. none of the above
2. (3) What functional dependencies would be satisfied by inserting the tuples (a1,b2,c2,d2) and (a1,b3,c1,d1) in the table:
 - ☐ A. $A \rightarrow B$
 - ☒ B. $A \rightarrow D$
 - C. $B \rightarrow D$
 - D. $D \rightarrow A$
 - E. none of the above
3. (3) What functional dependencies would be satisfied by inserting the tuples (a1,b1,c1,d2), (a1,b2,c1,d2), (a1,b1,c2,d1) and (a1,b3,c2,d1) in the table:
 - A. $A \rightarrow B$
 - B. $A \rightarrow D$
 - ☒ C. $D \rightarrow B$
 - ☐ D. $B \rightarrow A$
 - E. none of the above
4. (3) What functional dependencies would be satisfied by inserting the tuple (a2,b1,c1,d1) in the table:
 - A. $B \rightarrow A$
 - B. $A \rightarrow D$
 - C. $D \rightarrow B$
 - D. $D \rightarrow A$
 - ☒ E. none of the above

5. Consider the relation $R = \{a, b, c, d, E\}$ and the set of functional dependencies $FD = \{\{b\} \rightarrow \{c\}\}$ and the set of MVDs $= \{\{a\} \twoheadrightarrow \{b\}, \{c\} \twoheadrightarrow \{d\}\}$.

1. (1) Write all the candidate keys for R.

$$(A, E, D, E)^+$$

2. (3) Decompose the relation R into 4NF relations.

$$R_1 = \{b, c\} \quad R_2 = \{b, d\} \quad R_3 = \{a, b, c\} \quad R_4 = \{b, c, e\}$$

$$R_1 = \{b, d\} \quad R_2 = \{a, c\} \quad R_3 = \{a, d, e\}$$

6. (6) Consider a relation $R(A,B,C,D)$ that satisfies $A \twoheadrightarrow B$ and $A \twoheadrightarrow C$. Prove that $A \twoheadrightarrow BC$ using some of the MVD rules I went over in class.

According to rule #7 in the notes $A \twoheadrightarrow B, A \twoheadrightarrow C \Rightarrow A \twoheadrightarrow BC$
 Since if

a_1	b_1	c_1	d_1
a_1	b_1	c_2	d_2
a_1	b_2	c_1	d_2
a_1	b_2	c_2	d_2

