

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.
  
  
  
  
  
  
  
  
  
  
2. (6) What schema(s) would be produced by the 4NF decomposition algorithm?
  - A.  $R_1(a,d), R_2(b,c), R_3(a,b), R_4(a,E)$
  - B.  $R_1(b,d), R_2(b,c), R_3(a,b), R_4(a,E)$
  - 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.

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

- A.  $R1=\{a,b\}, R2=\{a,d\}, R3=\{a,c,E\}$
- B.  $R1=\{a,b\}, R2=\{a,E\}, R3=\{a,c\}, R4=\{a,d\}$
- C.  $R1=\{a,b\}, R2=\{a,d,E\}, R3=\{a,c\}$
- D.  $R1=\{a,b,E\}, R2=\{a,b\}, R3=\{a,c\}, R4=\{a,d\}$

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.

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

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
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.
2. (2) Identify one candidate key.

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

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.  $A \twoheadrightarrow B$
  - B.  $A \twoheadrightarrow D$
  - C.  $B \twoheadrightarrow A$
  - D.  $B \twoheadrightarrow D$
  - 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.  $A \twoheadrightarrow B$
  - B.  $A \twoheadrightarrow D$
  - C.  $B \twoheadrightarrow D$
  - D.  $D \twoheadrightarrow A$
  - 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.  $A \twoheadrightarrow B$
  - B.  $A \twoheadrightarrow D$
  - C.  $D \twoheadrightarrow B$
  - D.  $B \twoheadrightarrow A$
  - 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.  $B \twoheadrightarrow A$
  - B.  $A \twoheadrightarrow D$
  - C.  $D \twoheadrightarrow B$
  - D.  $D \twoheadrightarrow A$
  - 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.

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

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.