EXERCISES
on
Functional Dependencies, Normalization, Lossless Join

QUESTIONS

Question 1: Consider relation R=(A,B,C,D) with the following FDs:

AB → C, C → D, and D → A

a. List all candidate keys of R.
b. Isf R in 3NF? BCNF??

Question 2: Consider relation S=(A,B,C,D) with the following FDs:

A → B, B → C, C → D, and D → A

a. List all candidate keys of S.
b. Is S in 3NF? in BCNF?

Question 3: Given relation R=(A,B,C,D), find if R is in 3NF or BCNF with respect to the following FDs (each Roman-numeral question is separate):

i. B →C, C → A, C → D
ii. ABC → D, D → A
iii. A → C, B→ D

Question 4: Consider a relation R=(A,B,C,D,E,F) that satisfies the following four FDs:

AB → C, BC → AD, D → E, CF → B

Does AB → D hold? If so, show a formal proof; otherwise, give a counterexample.

Question 5: Consider a relation R=(A,B,C). For each of the following rules/implications, determine whether it holds (i.e., yes or no). If yes, provide a formal proof; otherwise, give a counterexample.

i. If AB → C, then A → C?
ii. If AB → C, then B → C?
iii. If AB → C, then (A → C) or (B → C)?

ANSWERS

Question 1:

a. 3 candidate keys for R: (**A,B), (B, C), (B, D)**

b. R is in **3NF, but not in BCNF**

Question 2:

a. 4 candidate keys for S: **A, B, C, D**

b. S is in **BCNF**

Question 3:

i. B is the candidate key and R is not in 3NF

ii. (A,B,C), (B,C,D) are candidate keys and R is in 3NF, but not in BCNF

iii. (A,B) is the key and R is not in 3NF

Question 4:

Yes, AB → D holds. Here is a proof:

1. AB → B	reflexivity
2. AB → BC	union: 1 and FD1
3. AB→ AD	transitivity: 2 and FD2
4. AB → D	decomposition: 3

Or you can compute {A, B}+

Question 5:

i. No, counterexample:

A	B	C
1	1	1
1	2	2

ii. No, counterexample:

A	B	C
1	1	1
2	1	2

iii. No, counterexample:

A	B	C
1	1	1
1	2	2
2	1	2