Database Normalization – Exercise Practices on 3NF

Q.1 Suppose a relational schema R (A B C D E) and set of functional dependencies

F: { A → B
B → E
C → D }

Check out that relation is in 3NF or not? If not decompose it in 3NF.

Solution1:

Firstly find the candidate key in the relation:

$(AC)^+$ = ABCDE

AC is the candidate key, because closure of AC has all the attributes of R.

Prime attributes: AC

Non prime attributes: BDE

A relation is said to be 3NF, if it holds at least one of the following for every non trivial functional dependency $\alpha \rightarrow \beta$:

- **α is super key.**
- **β is prime attribute.**

A → B -- Neither A is super key, nor B is prime attribute.

B → E -- Neither B is not super key, nor E is prime attribute.

C → D -- Neither C is not super key, nor D is prime attribute.

So, the relation is not in 3NF as it is not following the rules of 3NF.

Therefore, R(ABCDE) needs to be divided into following:

R1(A B E) → R_{11} (A B)

R2 (C D) → R_{12} (B E)

R3(A C)

Now R_{11}, R_{12}, R2, R3 are in 3NF.

Q.2 Suppose a relational schema R (A B C D E F G H I) and set of functional dependencies

F: { AB → C,
AD → GH,
BD → EF,
A → I,
H → J }

Check out that relation is in 3NF or not? If not decompose it in 3NF.

Solution 2:

Firstly find the candidate key in the relation:

$(ABD)^+$ = A B C D E F G H I

ABD is the candidate key, because closure of ABD has all the attributes of R.

Prime attributes: A B D

Non prime attributes: C E F G H I

A relation is said to be 3NF, if it holds at least one of the following for every non trivial functional dependency $\alpha \rightarrow \beta$:

- **α is super key.**
- **β is prime attribute.**

AB → C -- Neither AB is super key, nor C is prime attribute.

AD → GH -- Neither AD is not super key, nor GH is prime attribute.

BD → EF -- Neither BD is not super key, nor EF is prime attribute.

A → I -- Neither A is not super key, nor I is prime attribute.

H → J -- Neither H is not super key, nor J is prime attribute.

So, the relation is not in 3NF as it is not following the rules of 3NF.

Therefore, R(ABCDE) needs to be divided into following:

R1(A B C I) → R_{11} (A B C)

R1(A B C I) → R_{12} (A I)

R2 (A D G H J) → R_{21} (A D G H)

R2 (A D G H J) → R_{22} (H J)

R3(B D E F)

R4(A B D)

Now R_{11}, R_{12}, R_{21}, R_{22}, R3, R4 are in 3NF.