Example-

Consider a relation- R (V , W , X , Y , Z) with functional dependencies-

$VW \rightarrow XY$

$Y \rightarrow V$

$WX \rightarrow YZ$

The possible candidate keys for this relation are-

VW , WX , WY

From here,

- Prime attributes = { V , W , X , Y }
- Non-prime attributes = { Z }

Now, if we observe the given dependencies-

- There is no partial dependency.
- This is because there exists no dependency where incomplete candidate key determines any non-prime attribute.

Thus, we conclude that the given relation is in 2NF.

Third Normal Form-

A given relation is called in Third Normal Form (3NF) if and only if-

1. Relation already exists in 2NF.
2. No transitive dependency exists for non-prime attributes.

Transitive Dependency

A → B is called a transitive dependency if and only if-

1. A is not a super key.
2. B is a non-prime attribute.

If any one condition fails, then it is not a transitive dependency.

NOTE-

- Transitive dependency must not exist for non-prime attributes.
- However, transitive dependency can exist for prime attributes.

OR

A relation is called in Third Normal Form (3NF) if and only if-

Any one condition holds for each non-trivial functional dependency A → B

1. A is a super key
2. B is a prime attribute

Example-

Consider a relation- R (A , B , C , D , E) with functional dependencies-

$A \rightarrow BC$

$CD \rightarrow E$

$B \rightarrow D$

$E \rightarrow A$

The possible candidate keys for this relation are-

A , E , CD ,

From here,

- Prime attributes = { A , B , C , D , E }
- There are no non-prime attributes

Now,

- It is clear that there are no non-prime attributes in the relation.

- In other words, all the attributes of relation are prime attributes.
- Thus, all the attributes on RHS of each functional dependency are prime attributes.

Thus, we conclude that the given relation is in 3NF.

Boyce-Codd Normal Form-

A given relation is called in BCNF if and only if-

1. Relation already exists in 3NF.
2. For each non-trivial functional dependency $A \rightarrow B$, A is a super key of the relation.

Example-

Consider a relation- R (A , B , C) with the functional dependencies-

$A \rightarrow B$

$B \rightarrow C$

$C \rightarrow A$

The possible candidate keys for this relation are-

A , B , C

Now, we can observe that RHS of each given functional dependency is a candidate key.

Thus, we conclude that the given relation is in BCNF.