Fourth Normal Form (4NF)

Fourth Normal Form comes into picture when **Multi-valued Dependency** occur in any relation. In this tutorial we will learn about Multi-valued Dependency, how to remove it and how to make any table satisfy the fourth normal form.

Follow the video above for complete explanation of 4th Normal Form. Or, if you want, you can even skip the video and jump to the section below for the complete tutorial.

In our last tutorial, we learned about the **boyce-codd normal form**, we suggest you to follow the last tutorial before this one.

Rules for 4th Normal Form

For a table to satisfy the Fourth Normal Form, it should satisfy the following two conditions:

1. It should be in the **Boyce-Codd Normal Form**.
2. And, the table should not have any **Multi-valued Dependency**.

Let's try to understand what multi-valued dependency is in the next section.

What is Multi-valued Dependency?

A table is said to have multi-valued dependency, if the following conditions are true,

1. For a dependency A → B, if for a single value of A, multiple value of B exists, then the table may have multi-valued dependency.
2. Also, a table should have at-least 3 columns for it to have a multi-valued dependency.
3. And, for a relation `R(A,B,C)`, if there is a multi-valued dependency between, A and B, then B and C should be independent of each other.

If all these conditions are true for any relation(table), it is said to have multi-valued dependency.

Time for an Example

Below we have a college enrolment table with columns `s_id`, `course` and `hobby`.

s_id	course	hobby
1	Science	Cricket
1	Maths	Hockey
2	C#	Cricket
2	Php	Hockey

As you can see in the table above, student with `s_id` **1** has opted for two courses, **Science** and **Maths**, and has two hobbies, **Cricket** and **Hockey**.

You must be thinking what problem this can lead to, right?

Well the two records for student with `s_id` **1**, will give rise to two more records, as shown below, because for one student, two hobbies exists, hence along with both the courses, these hobbies should be specified.

s_id	course	hobby
1	Science	Cricket
1	Maths	Hockey
1	Science	Hockey
1	Maths	Cricket

And, in the table above, there is no relationship between the columns `course` and `hobby`. They are independent of each other.

So there is multi-value dependency, which leads to un-necessary repetition of data and other anomalies as well.

How to satisfy 4th Normal Form?

To make the above relation satify the 4th normal form, we can decompose the table into 2 tables.

CourseOpted Table

s_id	course
1	Science
1	Maths
2	C#
2	Php

And, **Hobbies Table**,

s_id	hobby
1	Cricket
1	Hockey
2	Cricket
2	Hockey

Now this relation satisfies the fourth normal form.

A table can also have functional dependency along with multi-valued dependency. In that case, the functionally dependent columns are moved in a separate table and the multi-valued dependent columns are moved to separate tables.

If you design your database carefully, you can easily avoid these issues.