



Fourth Normal Form

Multivalued Dependency

- Multivalued dependency occurs when two attributes in a table are independent of each other but, both depend on a third attribute.
- A multivalued dependency consists of at least two attributes that are dependent on a third attribute that's why it always requires at least three attributes.

Multivalued Dependency

- If $A \twoheadrightarrow B$ (read as A multi determines B) exists, for a single value of A, more than one value of B exists.
- Table should have at least three columns.
- For the table with A, B, C as three attributes, B and C should be independent.

If all the above conditions are true, then the table may be in multivalued dependency.

Multivalued Dependency

Std-ID	Course	Hobby
21	Computer	Dancing
21	Math	Singing
34	Chemistry	Dancing
74	Biology	Cricket
59	Physics	Hockey

Here Course and Hobby are independent of each other but Course is dependent on Std-ID and Hobby is dependent on Std-ID.

Fourth Normal Form

- A relation will be in 4NF if it is in Boyce Codd normal form and has no multi-valued dependency.
- For a dependency $A \twoheadrightarrow B$, if for a single value of A, multiple values of B exists, then the relation will be a multi-valued dependency.

Fourth Normal Form

STUDENT

STU_ID	COURSE	HOBBY
21	Computer	Dancing
21	Math	Singing
34	Chemistry	Dancing
74	Biology	Cricket
59	Physics	Hockey

The given STUDENT table is in 3NF, but the COURSE and HOBBY are two independent entity. Hence, there is no relationship between COURSE and HOBBY.

In the STUDENT relation, a student with STU_ID, **21** contains two courses, **Computer** and **Math** and two hobbies, **Dancing** and **Singing**. So there is a Multi-valued dependency on STU_ID, which leads to unnecessary repetition of data.

So to make the above table into 4NF, we can decompose it into two tables:

Fourth Normal Form

STUDENT_COURSE

STU_ID	COURSE
21	Computer
21	Math
34	Chemistry
74	Biology
59	Physics

STUDENT_HOBBY

STU_ID	HOBBY
21	Dancing
21	Singing
34	Dancing
74	Cricket
59	Hockey

Fifth Normal Form

- A relation is in 5NF if it is in 4NF and no join dependency exists.
- It can't be further non loss decomposed.
- 5NF is satisfied when all the tables are broken into as many tables as possible in order to avoid redundancy.
- 5NF is also known as Project-join normal form (PJ/NF).

Join Dependency

- If the join of R_1 and R_2 over C is equal to relation R , then we can say that a join dependency (JD) exists.
- Where R_1 and R_2 are the decompositions $R_1(A, B, C)$ and $R_2(C, D)$ of a given relations $R(A, B, C, D)$.
- Alternatively, R_1 and R_2 are a lossless decomposition of R .
- A JD $\bowtie \{R_1, R_2, \dots, R_n\}$ is said to hold over a relation R if R_1, R_2, \dots, R_n is a lossless-join decomposition.

Example

Agent	Company	Product
AI	PQR	Nut
AI	PQR	Bolt
AI	XYZ	Nut
AI	XYZ	Bolt
A2	PQR	Nut

Agent	Company
AI	PQR
AI	XYZ
A2	PQR

Agent	Product
AI	Nut
AI	Bolt
A2	Nut

Company	Product
PQR	Nut
PQR	Bolt
XYZ	Nut
XYZ	Bolt



Thank You