Course Name: **A Level (1st Sem)** Subject : **Introduction to DBMS**

Topic: **DB Normalization – Fourth Normal Form (Part 14)** Date: **08-June-2020**

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## Database Normalization – Fourth Normal Form (4NF)

### Fourth Normal Form (4NF)

A relation (table) is said to in 4NF:

- If it is in BCNF.
- There must be **no multi valued dependency**.

**Multi valued dependency :**

Suppose a relation R (A B C), If multi valued dependency exists between A and B, then it is denoted by A ↠ B, It means for a single value of attribute A, there are multiple values of attribute B and there must be B and C independent to each other.

Note: There must be at least three attributes to occur multi valued dependency.

Consider the following table:

| stu_id | stu_mobile | stu_course |
|---|---|---|
| 101 | **89832** | **Java** |
| 101 | **98302** | **Python** |
| 102 | **45698** | **PHP** |
| 102 | **45698** | **Python** |
| 103 | **92342** | **Java** |
| 103 | **98364** | **Java** |

One Student can have multiple mobiles and One student can enroll on multiple courses.

The Candidate key in above table {stu_id, stu_mobile, stu_course}

The table stratifies the rule of BCNF [The whole attribute in the table are the part of the candidate key]

But the table still have data redundancy due to multi valued dependencies:

stu_id ↠ stu_mobile [ for stu_id 101 and 103, there are more than one mobile]

stu_id ↠ stu_course [ for stu_id 101 and 102, there are more than one course ]

stu_mobile and stu_course are also independent to each other.

**Therefore,** to satisfy 4NF, it needs to be decompose into

**R1 (stu_id, stu_mobile)**

**R2(stu_id, stu_course)**

[The multi valued dependent columns are moved into separate table.]

**See** how data redundancy is removed by decomposing it into 4NF:

R1(stu_id, stu_mobile)

| stu_id | stu_mobile |
|---|---|
| 101 | **89832** |
| 101 | **98302** |
| 102 | **45698** |
| 103 | **92342** |
| 103 | **98364** |

R2 (stu_id, stu_course)

| stu_id | stu_course |
|---|---|
| 101 | **Java** |
| 101 | **Python** |
| 102 | **PHP** |
| 102 | **Python** |
| 103 | **Java** |

R (stu_id, stu_mobile, stu_course)

| stu_id | stu_mobile | stu_course |
|---|---|---|
| 101 | **89832** | **Java** |
| 101 | **98302** | **Python** |
| 102 | **45698** | **PHP** |
| 102 | **45698** | **Python** |
| 103 | **92342** | **Java** |
| 103 | **98364** | **Java** |

- **Multi valued dependency exist:**
  - {stu_id ↠ stu_mobile, stu_id ↠ stu_course
  - stu_mobile and stu_course are indepdendent
- **Data Redundancy:**
  - For every new course, mobile needs to be repeated.
  - For every new mobile, course needs to be repeated.

**Exercise:**

1. What is fourth normal form? Explain with example.