

# Unit-3

Cont...

# 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.

**Example:** Suppose there is a bike manufacturer company which produces two colors(white and black) of each model every year.

BIKE_MODEL	MANUF_YEAR	COLOR
M2011	2008	White
M2001	2008	Black
M3001	2013	White
M3001	2013	Black
M4006	2017	White
M4006	2017	Black

Here columns COLOR and MANUF\_YEAR are dependent on BIKE\_MODEL and independent of each other. In this case, these two columns can be called as multivalued dependent on BIKE\_MODEL. The representation of these dependencies is shown below:

1.BIKE\_MODEL  $\twoheadrightarrow$  MANUF\_YEAR

2.BIKE\_MODEL  $\twoheadrightarrow$  COLOR

# 4NF

- Any relation is said to be in the fourth normal form when it satisfies the following conditions:
  - It must be in Boyce Codd Normal Form (BCNF).
  - It should have no multi-valued dependency.

**STUDENT**

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

# Join Dependency

- Join decomposition is a further generalization of Multivalued dependencies. 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 decomposition  $R_1(A, B, C)$  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.
- The  $*(A, B, C, D), (C, D)$  will be a JD of  $R$  if the join of join's attribute is equal to the relation  $R$ .
- Here,  $*(R_1, R_2, R_3)$  is used to indicate that relation  $R_1, R_2, R_3$  and so on are a JD of  $R$ .

# 5NF

- A relation is in Fifth Normal Form (5NF), if it is in 4NF, and won't have join dependency.
- You can also consider that a relation is in 5NF, if the candidate key implies every join dependency in it.

A relation R is in 5NF if and only if every join dependency in R is implied by the candidate keys of R. A relation decomposed into two relations must have loss-less join Property, which ensures that no spurious or extra tuples are generated, when relations are reunited through a natural join.

## Example

The below relation violates the Fifth Normal Form (5NF) of Normalization –

### <Employee>

EmpName	EmpSkills	EmpJob (Assigned Work)
David	Java	E145
John	JavaScript	E146
Jamie	jQuery	E146
Emma	Java	E147

The above relation can be decomposed into the following three tables; therefore, it is not in 5NF –

**<EmployeeSkills>**

EmpName	EmpSkills
David	Java
John	JavaScript
Jamie	jQuery
Emma	Java

The following is the <EmployeeJob> relation that displays the jobs assigned to each employee –

**<EmployeeJob>**

EmpName	EmpJob
David	E145
John	E146
Jamie	E146
Emma	E147

Here is the skills that are related to the assigned jobs –

**<JobSkills>**

EmpSkills	EmpJob
Java	E145
JavaScript	E146
jQuery	E146
Java	E147

## Example 2

A relation R satisfies join dependency if R is equal to the join of  $R_1, R_2, \dots, R_n$  where  $R_i$  is a subset of the set of attributes of R.

### Relation R

Dept	Subject	Name
CSE	C	Ammu
CSE	C	Amar
CSE	Java	Amar
IT	C	bhanu

The above relation says that dept offers many elective subjects which are taken by a variety of students. Students have the opinion to choose subjects. Therefore all three fields are needed to represent the information.

The above relation does not show non-trivial MVDs since the attributes subject and name are dependent; they are related to each other (A FD  $\text{subject} \rightarrow \text{name}$  exists). The relation cannot be decomposed in two relations (dept, subject) and (dept, sname).



Therefore the relation can be decomposed into following three relations –

R1(dept, subject)

R2(dept, name) and

R3(subject, name) and it can be shown that decomposition is lossless.

**R1**

Dept	Subject
CSE	C
CSE	Java
IT	C

**R2**

Dept	Name
CSE	Ammu
CSE	Amar
IT	bhanu

**R3**

Subject	Name
C	Ammu
C	Amar
Java	Amar
C	bhanu

### EXAMPLE - 3

**Properties** – A relation R is in 5NF if and only if it satisfies following conditions:

1. R should be already in 4NF.
2. It cannot be further non loss decomposed (join dependency)

**Example** – Consider the above schema, with a case as “if a company makes a product and an agent is an agent for that company, then he always sells that product for the company”. Under these circumstances, the ACP table is shown as:

**Table** – ACP

AGENT	COMPANY	PRODUCT
A1	PQR	Nut
A1	PQR	Bolt
A1	XYZ	Nut
A1	XYZ	Bolt
A2	PQR	Nut

Table – R1

AGENT	COMPANY
A1	PQR
A1	XYZ
A2	PQR

Table – R2

AGENT	PRODUCT
A1	Nut
A1	Bolt
A2	Nut

Table – R3

COMPANY	PRODUCT
PQR	Nut
PQR	Bolt
XYZ	Nut
XYZ	Bolt

Result of Natural Join of R1 and R3 over 'Company' and then Natural Join of R13 and R2 over 'Agent'and 'Product' will be table **ACP**.

Hence, in this example, all the redundancies are eliminated, and the decomposition of ACP is a lossless join decomposition. Therefore, the relation is in 5NF as it does not violate the property of lossless join.

## FAQs

### What is join dependency? Give examples.

Whenever we can recreate a table by simply joining various tables where each of these tables consists of a subset of the table's attribute, then this table is known as a Join Dependency.

Thus, it is like a generalization of MVD. We can relate the JD to 5NF. Herein, a relation can be in 5NF only when it's already in the 4NF. Remember that it cannot be further decomposed.

### What is multivalued and join dependency in DBMS?

A multivalued dependency is a case in which a determinant gets associated with some set of values. Whenever isolated, the MVD does not have modification anomalies.

Join dependency or JD is a constraint that is similar to FD (functional dependency) or MVD (multivalued dependency). JD is satisfied only when the concerned relation is a join of a specific number of projections. Thus, such a type of constraint is known as a join dependency.

### What is join dependency in 5NF?

Some relations can be in 5NF whenever it satisfies the 4NF and there exists no join dependency. Thus, a relation can have join dependency in case it can be recreated when we join multiple sub relations, while each of the sub relations contains a subset of the original relation's attributes.

### What is a multivalued dependency, and how do they affect the normalization process?

A multivalued dependency is a case in which a determinant gets associated with some set of values. Whenever isolated, the MVD does not have modification anomalies. Thus, the tables that have these isolated dependencies can be considered to be in the 4NF (fourth normal form).