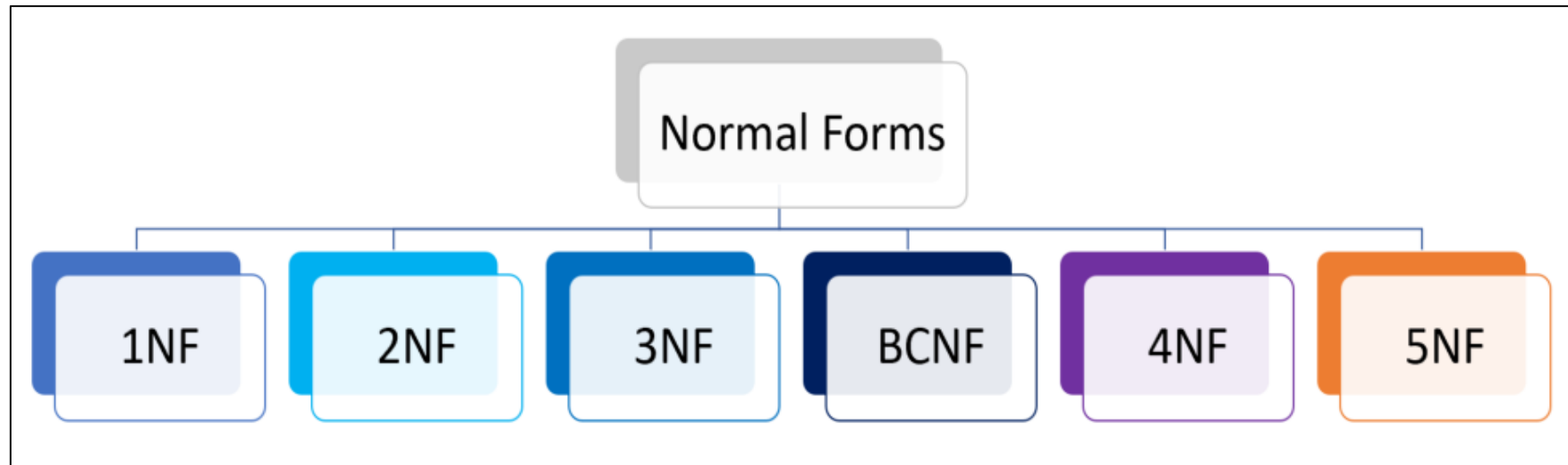


# Database Management Systems (BCSC-0003)

## Topic: Normalization



**Nikhil Govil**

Assistant Professor, Dept. of CEA, GLA University, Mathura.

# Normalization

- Normalization is a database design technique that reduces data redundancy and eliminates undesirable characteristics like Insertion, Update and Deletion Anomalies.
- Normalization rules divides larger tables into smaller tables and links them using relationships.
- The purpose of Normalization in SQL is to eliminate redundant (repetitive) data and ensure data is stored logically.

# Types of Normal Form

Here is a list of Normal Forms

- 1NF (First Normal Form)
- 2NF (Second Normal Form)
- 3NF (Third Normal Form)
- BCNF (Boyce-Codd Normal Form)
- 4NF (Fourth Normal Form)
- 5NF (Fifth Normal Form)
- 6NF (Sixth Normal Form)

# First Normal Form (1NF)

- A relation will be in 1NF if it contains an atomic value.
- It states that an attribute of a table cannot hold multiple values. It must hold only single-valued attribute.
- First normal form disallows the multi-valued attribute, composite attribute, and their combinations.

# First Normal Form (1NF)

## *Example:*

- Relation EMPLOYEE is not in 1NF because of multi-valued attribute EMP\_PHONE.

EMPLOYEE table:

EMP_ID	EMP_NAME	EMP_PHONE	STATE
2925	RAJESH	9500407832, 9088170884	TAMILNADU
6796	KISHORE	9510508668	KARNATAKA
4592	ALOK	8455661732	PUNJAB
3565	HEMANT	9759105522, 9414525254	GUJRAT

# First Normal Form (1NF)

The decomposition of the EMPLOYEE table into 1NF has been shown below:

EMP_ID	EMP_NAME	EMP_PHONE	STATE
2925	RAJESH	9500407832	TAMILNADU
2925	RAJESH	9088170884	TAMILNADU
6796	KISHORE	9510508668	KARNATAKA
4592	ALOK	8455661732	PUNJAB
3565	HEMANT	9759105522	GUJRAT
3565	HEMANT	9414525254	GUJRAT

# Second Normal Form (2NF)

- In the 2NF, relational must be in 1NF.
- In the second normal form, all non-key attributes are fully functional dependent on the primary key.

## *Example:*

Let's assume, a college can store the data of teachers and the subjects they teach. In a college, a teacher can teach more than one subject.

TEACHER table:

TEACHER_ID	SUBJECT	TEACHER_AGE
2529	Information Technology	30
2529	Soft Computing	30
6535	Data Communication	45
3578	Soft Computing	35
3578	Digital Image Processing	35

# Second Normal Form (2NF)

- In the given table, non-prime attribute TEACHER\_AGE is dependent on TEACHER\_ID. That's why it violates the rule for 2NF.
- To convert the given table into 2NF, we decompose it into two tables:

TEACHER\_DETAIL Table and

TEACHER\_SUBJECT Table:

TEACHER_ID	TEACHER_AGE
2529	30
6535	45
3578	35

TEACHER_ID	SUBJECT
2529	Information Technology
2529	Soft Computing
6535	Data Communication
3578	Soft Computing
3578	Digital Image Processing



# Third Normal Form (3NF)

- A relation will be in 3NF if it is in 2NF and not contain any transitive partial dependency.
- 3NF is used to reduce the data duplication. It is also used to achieve the data integrity.
- If there is no transitive dependency for non-prime attributes, then the relation must be in third normal form.

A relation is in third normal form if it holds at least one of the following conditions for every non-trivial function dependency  $X \rightarrow Y$ .

1. X is a super key.
2. Y is a prime attribute, i.e., each element of Y is part of some candidate key.

# Third Normal Form (3NF)

EMPLOYEE\_DETAIL table:

EMP_ID	EMP_NAME	EMP_ZIP	EMP_STATE	EMP_CITY
222	Harry	201010	UP	Noida
333	Stephan	02228	US	Boston
444	Lan	60007	US	Chicago
555	Katharine	06389	UK	Norwich
666	John	462007	MP	Bhopal

Super key in the table above:

{EMP\_ID}, {EMP\_ID, EMP\_NAME}, {EMP\_ID, EMP\_NAME, EMP\_ZIP}.... so on.

Candidate key: {EMP\_ID}

Non-prime attributes: In the given table, all attributes except EMP\_ID are non-prime.

Here, EMP\_STATE & EMP\_CITY dependent on EMP\_ZIP and EMP\_ZIP dependent on EMP\_ID. The non-prime attributes (EMP\_STATE, EMP\_CITY) transitively dependent on super key (EMP\_ID). It violates the rule of third normal form.

# Third Normal Form (3NF)

- That's why we need to move the EMP\_CITY and EMP\_STATE to the new <EMPLOYEE\_ZIP> table, with EMP\_ZIP as a Primary key.

EMPLOYEE table:

EMP_ID	EMP_NAME	EMP_ZIP
222	Harry	201010
333	Stephan	02228
444	Lan	60007
555	Katharine	06389
666	John	462007

EMPLOYEE\_ZIP Table:

EMP_ZIP	EMP_STATE	EMP_CITY
201010	UP	Noida
02228	US	Boston
60007	US	Chicago
06389	UK	Norwich
462007	MP	Bhopal

# Boyce-Codd Normal Form (BCNF)

- BCNF is the advance version of 3NF. It is stricter than 3NF.
- A table is in BCNF if every functional dependency  $X \rightarrow Y$ ,  $X$  is the super key of the table.
- For BCNF, the table should be in 3NF, and for every FD, LHS is super key.

**EMPLOYEE table:**

EMP_ID	EMP_COUNTRY	EMP_DEPT	DEPT_TYPE	EMP_DEPT_NO
264	India	Designing	D394	283
264	India	Testing	D394	300
364	UK	Stores	D283	232
364	UK	Developing	D283	549

# Boyce-Codd Normal Form (BCNF)

In the above table Functional dependencies are as follows:

- $EMP\_ID \rightarrow EMP\_COUNTRY$
- $EMP\_DEPT \rightarrow \{DEPT\_TYPE, EMP\_DEPT\_NO\}$

**EMP\_COUNTRY table:**

EMP_ID	EMP_COUNTRY
264	India
264	India

**EMP\_DEPT table:**

EMP_DEPT	DEPT_TYPE	EMP_DEPT_NO
Designing	D394	283
Testing	D394	300
Stores	D283	232
Developing	D283	549

**EMP\_DEPT\_MAPPING table:**

EMP_ID	EMP_DEPT
D394	283
D394	300
D283	232
D283	549

# References



- Korth, Silbertz and Sudarshan (1998), “Database Concepts”, 4th Edition, TMH.
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*Thank  
you*

