Chandigarh College of Engineering & Technology (Degree Wing)

Department of Computer Science and Engineering

Database Systems (Practical)

CS 352

Practical - 11

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AIM :- To study and illustrate 1st , 2nd , 3rd ,4th and 5th NF with two examples each, by running on WAMP/ LAMP /XAMPP /SQL server.

1. 1st Normal Form (1NF)

1NF requires that:

- Each column contains atomic values (no repeating groups).
- There are no arrays or multiple values in a single column.

Example 1:- account Table (already in 1NF)

The account table is already in 1NF as all columns contain atomic values.

Query :- SELECT * FROM account;

account_number	branch_name	balance
A-101	Downtown	500
A-102	Perryridge	400
A-201	Brighton	900
A-215	Mianus	700
A-217	Brighton	750
A-222	Redwood	700
A-305	Round Hill	350

Example 2 :- borrower Table (already in 1NF)

Query :- SELECT * FROM `borrower`;

	customer_name	loan_number
Edit Copy Delete	Smith	L-11
Edit Copy Delete	Jackson	L-14
Edit Copy Delete	Hayes	L-15
Edit Copy Delete	Adams	L-16
Edit Copy Delete	Williams	L-17
Edit Copy Delete	Smith	L-23
Edit Copy Delete	Curry	L-93

2. 2nd Normal Form (2NF)

2NF requires that:

- The table is in 1NF.
- There are no partial dependencies (every non-key attribute must depend on the whole primary key).

Example : The loan table, with loan_number as the primary key, is already in **2NF** because there are no partial dependencies.

Query :- SELECT * FROM `loan`

loan_number	branch_name	amount
L-11	Round Hill	900
L-14	Downtown	1500
L-15	Perryridge	1500
L-16	Perryridge	1300
L-17	Downtown	1000
L-23	Redwood	2000
L-93	Mianus	500

Table - 1

Query :- SELECT loan_number , branch_name FROM loan;

loan_number	branch_name
L-11	Round Hill
L-14	Downtown
L-15	Perryridge
L-16	Perryridge
L-17	Downtown
L-23	Redwood
L-93	Mianus

Table - 2

Query :- SELECT loan_number , amount FROM loan;

loan_number	amount
L-11	900
L-14	1500
L-15	1500
L-16	1300
L-17	1000
L-23	2000
L-93	500

3. 3rd Normal Form (3NF)

3NF requires that:

- The table is in 2NF.
- There are no transitive dependencies (non-key attributes depend only on the primary key).

Example 1 :- account Table (already in 3NF)

The account table already satisfies **3NF** because there are no transitive dependencies. The primary key account_number uniquely determines the attributes, and there is no indirect dependency on non-key columns.

Query :- SELECT * FROM account;

account_number	branch_name	balance
A-101	Downtown	500
A-102	Perryridge	400
A-201	Brighton	900
A-215	Mianus	700
A-217	Brighton	750
A-222	Redwood	700
A-305	Round Hill	350

Example 2 :- branch Table (not in 3NF)

In the branch table, branch_city is dependent on branch_name, and assets is also related to branch_name. But assets is not dependent on branch_city directly. There is a transitive dependency here

Query :- SELECT * FROM `branch`

branch_name	branch_city	assets
Brighton	Brooklyn	7100000
Downtown	Brooklyn	9000000
Mianus	Horseneck	400000
North Town	Rye	3700000
Perryridge	Horseneck	1700000
Pownal	Bennington	300000
Redwood	Palo Alto	2100000
Round Hill	Horseneck	8000000

Solution to bring branch to 3NF:

To remove transitive dependency, we split the table:

Query :- Split into two tables to remove transitive dependency

```
CREATE TABLE branch_assets ( branch_name varchar(50) PRIMARY KEY, assets int );

CREATE TABLE branch_city ( branch_name varchar(50) PRIMARY KEY, branch_city varchar(50) );

INSERT INTO branch_assets (branch_name, assets) SELECT branch_name, assets FROM branch;

INSERT INTO branch_city (branch_name, branch_city) SELECT branch_name, branch_city FROM branch;

SELECT * FROM branch_assets;

SELECT * FROM branch_city;
```

Table - 1

branch_name	assets
Brighton	7100000
Downtown	9000000
Mianus	400000
North Town	3700000
Perryridge	1700000
Pownal	300000
Redwood	2100000
Round Hill	8000000

Table - 2

branch_name	branch_city
Brighton	Brooklyn
Downtown	Brooklyn
Mianus	Horseneck
North Town	Rye
Perryridge	Horseneck
Pownal	Bennington
Redwood	Palo Alto
Round Hill	Horseneck

4. 4th Normal Form (4NF)

4NF requires that:

- The table is in BCNF.
- There are no multi-valued dependencies (no column that is multi-valued and independent)

Example 1: customer Table (not in 4NF)

Suppose a table contains multiple values in a column, like storing both phone numbers and email addresses for customers. This creates a multi-valued dependency.

Query :- SELECT * FROM `customer`

Customer_Name	Customer_Street	Customer_City
Brooks	Senator	Brooklyn
Curry	North	Rye
Glenn	Sandhill	Woodside
Green	Walnut	Stamford
Hayes	Main	Harrison
Johnson	Alma	Palo Alto
Jones	Main	Harrison
Lindsay	Park	Pittsfield
Smith	North	Rye
Turner	Putnam	Stamford
Williams	Nassaw	Princeton
Adams	Spring	Pittsfield

Solution to bring customer to 4NF:
We split the multi-valued attributes into separate tables:

Query : - -- Split into two tables to remove multi-valued dependency

```
CREATE TABLE customer_street(
    customer_name varchar(50),
    customer_street varchar(20),
    PRIMARY KEY (customer_name, customer_street)
);

CREATE TABLE customer_city (
    customer_name varchar(50),
    customer_city varchar(50),
    PRIMARY KEY (customer_name, customer_city)
);

-- Populating the tables
INSERT INTO customer_street (customer_name, customer_street)
SELECT customer_name, customer_street FROM customer;

INSERT INTO customer_city (customer_name, customer_street)
SELECT customer_name, customer_city FROM customer;

-- Now, the customer table is in 4NF
SELECT * FROM customer_street;
SELECT * FROM customer_city;
```

Table - 1

Customer_Name	Customer_Street
Brooks	Senator
Curry	North
Glenn	Sandhill
Green	Walnut
Hayes	Main
Johnson	Alma
Jones	Main
Lindsay	Park
Smith	North
Turner	Putnam
Williams	Nassaw
Adams	Spring

Table - 2

Customer_Name	Customer_City
Brooks	Brooklyn
Curry	Rye
Glenn	Woodside
Green	Stamford
Hayes	Harrison
Johnson	Palo Alto
Jones	Harrison
Lindsay	Pittsfield
Smith	Rye
Turner	Stamford
Williams	Princeton
Adams	Pittsfield

Example 2 :- depositor Table already in 4NF.

Query :- SELECT * FROM `depositor`

customer_name	account_number
Johnson	A-101
Hayes	A-102
Johnson	A-201
Smith	A-215
Jones	A-217
Lindsay	A-222
Turner	A-305

5. Fifth Normal Form (5NF)

A table is in 5NF if:

- ❖ It is in 4NF.
- ❖ It contains no join dependency and cannot be decomposed further without loss of information.

Examples :- Non 5th Normal form Table account

account_number	branch_name	balance
A-101	Downtown	500
A-102	Perryridge	400
A-201	Brighton	900
A-215	Mianus	700
A-217	Brighton	750
A-222	Redwood	700
A-305	Round Hill	350

Decomposed Tables

Table - 1

account_number	branch_name
A-101	Downtown
A-102	Perryridge
A-201	Brighton
A-215	Mianus
A-217	Brighton
A-222	Redwood
A-305	Round Hill

Table - 2

account_number	balance
A-101	500
A-102	400
A-201	900
A-215	700
A-217	750
A-222	700
A-305	350