Normalization

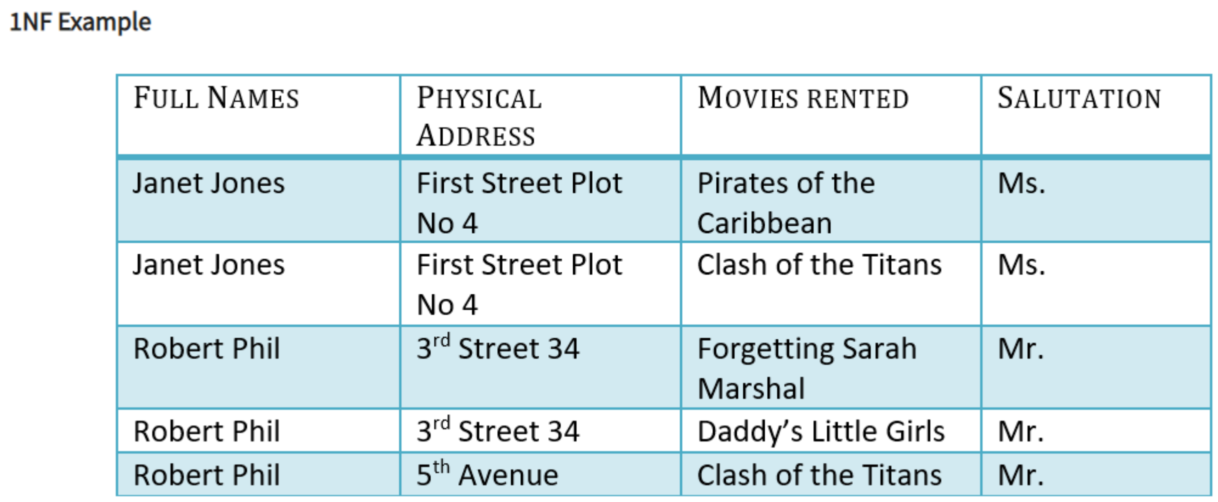
Normalization is a database design technique that reduces data redundancy and eliminates undesirable characteristics like Insertion, Update and Deletion Anomalies.

- Normalization divides larger tables into smaller tables and links them using relationships.
- The purpose of Normalization is to eliminate redundant data and ensure data is stored logically.

All Normal Forms & Their Rules

Associates only need to know up to 3NF.

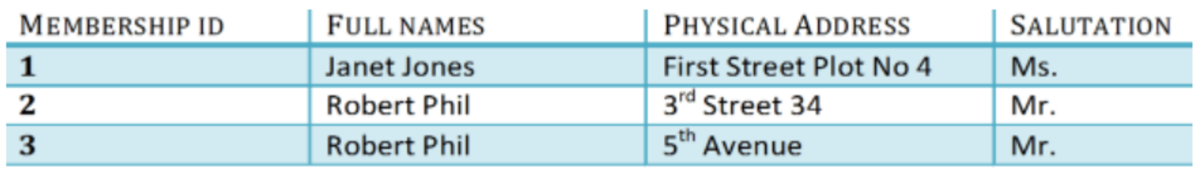
- **1NF (First Normal Form)**:
  - Each table cell should contain a single value.
  - Each record needs to be unique.



1NF Example

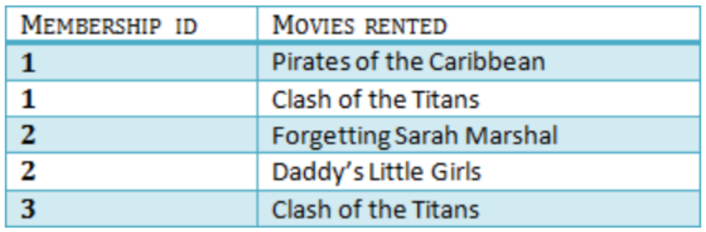
FULL NAMES	PHYSICAL ADDRESS	MOVIES RENTED	SALUTATION
Janet Jones	First Street Plot No 4	Pirates of the Caribbean	Ms.
Janet Jones	First Street Plot No 4	Clash of the Titans	Ms.
Robert Phil	3rd Street 34	Forgetting Sarah Marshal	Mr.
Robert Phil	3rd Street 34	Daddy's Little Girls	Mr.
Robert Phil	5th Avenue	Clash of the Titans	Mr.

- **2NF (Second Normal Form)**:
  - Be in 1NF.
  - Single column primary key. (No partial dependencies)



MEMBERSHIP ID	FULL NAMES	PHYSICAL ADDRESS	SALUTATION
1	Janet Jones	First Street Plot No 4	Ms.
2	Robert Phil	3rd Street 34	Mr.
3	Robert Phil	5th Avenue	Mr.

Table 1



MEMBERSHIP ID	MOVIES RENTED
1	Pirates of the Caribbean
1	Clash of the Titans
2	Forgetting Sarah Marshal
2	Daddy's Little Girls
3	Clash of the Titans

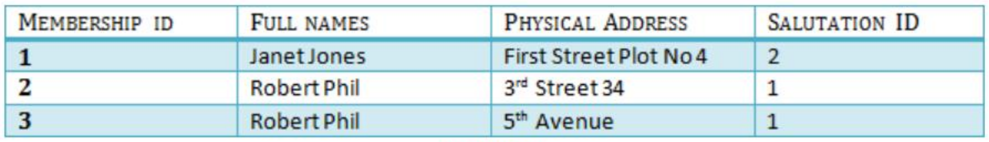
Table 2

In order to achieve 2NF from the first table, we have divided it into two tables. Table 1 contains member information. Table 2 contains information on movies rented. In order to put this table into 2NF, we have created a new column called `Membership_ID` which is the **primary key** for Table 1. Records can be uniquely identified in Table 1 using `Membership_ID`.

In Table 2, `Membership_ID` is the **foreign key**.

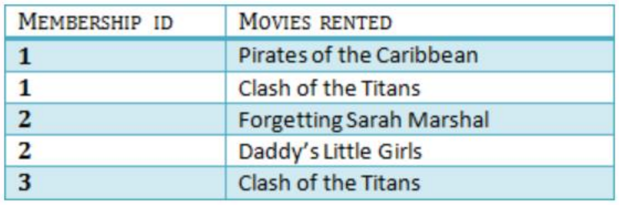
- **3NF (Third Normal Form) Rules**
    - Be in 2NF.
    - Has no transitive dependencies.

3NF Example



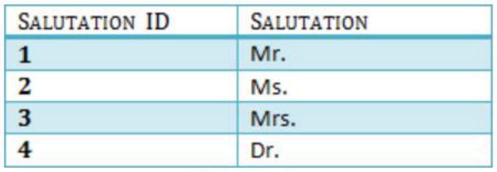
Membership ID	Full Names	Physical Address	Salutation ID
1	Janet Jones	First Street Plot No 4	2
2	Robert Phil	3rd Street 34	1
3	Robert Phil	5th Avenue	1

TABLE 1



Membership ID	Movies Rented
1	Pirates of the Caribbean
1	Clash of the Titans
2	Forgetting Sarah Marshal
2	Daddy's Little Girls
3	Clash of the Titans

Table 2



Salutation ID	Salutation
1	Mr.
2	Ms.
3	Mrs.
4	Dr.

Table 3

We have again divided our tables and created a new table which stores `Salutations`. There are no transitive functional dependencies, and hence our table is in 3NF. In Table 3 `Salutation_ID` is **primary key**, and in Table 1 `Salutation ID` is **foreign to primary key** in Table 3.

Normalization Demo in DBeaver:

1. First we will create a `customers` table that is NOT in 1NF because the name attribute is not atomic in nature. The Name could be broken into first name, last name - or first name, middle name, last name, etc. Run the following:

```
CREATE TABLE IF NOT EXISTS customers (
        id SERIAL PRIMARY KEY,
        name VARCHAR(40), -- Could fix by breaking this column into several atomic
columns (i.e, first, last)
        phone VARCHAR(10),
        phone_type VARCHAR(20) -- <-- Violates 3rd normal form, describes phones, not 
customers. makes no sense with no phone column
);

-- Then populate some rows
INSERT INTO customers (name, phone) VALUES
    ('Abby Adams', '5554443333'),
    ('Billy Bob', '1112223333'),
    ('Cathy McCarthy', '2224446666');
```

2. We will now create a set of tables in 2NF and 3NF. Ask associates why some columns violate the NF rules:

```
CREATE TABLE IF NOT EXISTS store (
        id SERIAL PRIMARY KEY,
        name VARCHAR(15)
);

INSERT INTO store (name) VALUES ('Big Store'), ('Little Store'), ('Medium Store'),
('Jumbo Store');

CREATE TABLE IF NOT EXISTS purchases (
        customer_id INTEGER REFERENCES customers(id),
        store_id INTEGER REFERENCES store(id),
        customer_email VARCHAR(40) UNIQUE, -- <-- This column violates 2NF, 
customer_email is not about both parts of the key
        PRIMARY KEY(customer_id, store_id)
);

CREATE TABLE IF NOT EXISTS order_detail (
        id SERIAL PRIMARY KEY,
        purchase_id INTEGER,
        price INTEGER,
        quantity INTEGER,
        total INTEGER  -- <-- Our problem. Total is functionally dependant upon price 
and quantity and violates 3NF
                        -- Total would need to be divided further in order
);
```