Oracle SQL Normalization

Normalization is the process of organizing data in a database to reduce redundancy and improve data integrity. In relational database management systems (RDBMS) like Oracle SQL, normalization involves dividing large tables into smaller, manageable ones and defining relationships between them.

The primary goal of normalization is to ensure that the data is stored efficiently, with minimal duplication, and can be easily updated without anomalies (insertion, update, and deletion anomalies).

Here is a detailed explanation of Oracle SQL Normalization with examples:

1. First Normal Form (1NF)
Definition:
A relation (table) is in First Normal Form (1NF) if:
- Each column contains atomic (indivisible) values.
- Each record (row) is unique (no duplicate rows).
- The order in which data is stored does not matter.

1NF Rules:
- Each cell in a table should contain only one value (no arrays or lists).
- Each column must have unique names.
- All entries in a column must be of the same data type.

Example of 1NF:

Before 1NF (Unnormalized Table):

StudentID	StudentName	Courses
1	John	Math, Science
2	Jane	History, Math

After 1NF (Normalized Table):

StudentID	StudentName	Course
1	John	Math
1	John	Science
2	Jane	History
2	Jane	Math

2. Second Normal Form (2NF)
Definition:
A relation (table) is in Second Normal Form (2NF) if:

- It is in 1NF.
- It has no partial dependency. All non-key attributes must depend on the entire primary key, not just part of it.

Example of 2NF:

Before 2NF (1NF Table with Partial Dependency):

StudentID | CourseID | StudentName | Instructor
1 | 101 | John | Mr. Smith
1 | 102 | John | Mrs. Taylor
2 | 101 | Jane | Mr. Smith

After 2NF (Normalized Tables):

Student-Course Table:

StudentID | CourseID | StudentName
1 | 101 | John
1 | 102 | John
2 | 101 | Jane

Course-Instructor Table:

CourseID | Instructor
101 | Mr. Smith
102 | Mrs. Taylor

3. Third Normal Form (3NF)
Definition:
A relation (table) is in Third Normal Form (3NF) if:
- It is in 2NF.
- It has no transitive dependency. Non-key attributes should not depend on other non-key attributes.

Example of 3NF:

Before 3NF (2NF Table with Transitive Dependency):

StudentID | CourseID | StudentName | Instructor | InstructorPhone
1 | 101 | John | Mr. Smith | 12345
1 | 102 | John | Mrs. Taylor | 67890
2 | 101 | Jane | Mr. Smith | 12345

After 3NF (Normalized Tables):

Student-Course Table:

```
StudentID | CourseID | StudentName
1         | 101      | John
2         | 102      | Jane
```

Course-Instructor Table:

```
CourseID | Instructor
101      | Mr. Smith
102      | Mrs. Taylor
```

Instructor-Phone Table:

```
Instructor  | InstructorPhone
Mr. Smith   | 12345
Mrs. Taylor | 67890
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Conclusion

Normalization is a crucial concept in database design to ensure data integrity, reduce redundancy, and facilitate easier maintenance and updates. In Oracle SQL, normalization is implemented by structuring tables and relationships to satisfy different normal forms, primarily 1NF, 2NF, and 3NF, each addressing specific data integrity issues.