Siddiqui Tabish Javed
Roll No: 231456
SE IT Engg

Normalization in database design ensures that the data is organized efficiently by reducing redundancy and improving data integrity. The following is a step-by-step normalization of a Library Management System.

Step 1: Unnormalized Table

In the unnormalized table, the data is not well-organized, with repeated values for books, authors, and borrowers. The following table represents the unnormalized form:

Unnormalized Table:

BookID	BookTitle	AuthorID	AuthorName	BorrowerID	BorrowerName	BorrowDate	ReturnDate
1	Book A	101	John Doe	201	Alice	01-10-2024	15-10-2024
2	Book B	102	Jane Roe	202	Bob	05-10-2024	20-10-2024
3	Book C	103	Mike Smith	203	Charlie	10-10-2024	25-10-2024
1	Book A	101	John Doe	202	Bob	15-10-2024	30-10-2024

Step 2: First Normal Form (1NF)

In the First Normal Form (1NF), we ensure that each column contains atomic values and there are no repeating groups. We can split the table into separate entities for books, authors, and borrowers.

Books Table after 1NF:

BookID	BookTitle	AuthorID	AuthorName	BorrowerID	BorrowerName	BorrowDate	ReturnDate
1	Book A	101	John Doe	201	Alice	01-10-2024	15-10-2024
2	Book B	102	Jane Roe	202	Bob	05-10-2024	20-10-2024
3	Book C	103	Mike Smith	203	Charlie	10-10-2024	25-10-2024
1	Book A	101	John Doe	202	Bob	15-10-2024	30-10-2024

Step 3: Second Normal Form (2NF)

In the Second Normal Form (2NF), partial dependencies are removed. We split the data into separate tables for books, authors, and borrowers, ensuring that all non-key attributes depend on the primary key.

Books Table (2NF):

BookID	BookTitle
1	Book A
2	Book B
3	Book C

Authors Table (2NF):

AuthorID	AuthorName
101	John Doe
102	Jane Roe
103	Mike Smith

Borrowers Table (2NF):

BorrowerID	BorrowerName
201	Alice
202	Bob
203	Charlie

Borrowing Transactions Table (2NF):

BookID	BorrowerID	BorrowDate	ReturnDate
1	201	01-10-2024	15-10-2024
2	202	05-10-2024	20-10-2024
3	203	10-10-2024	25-10-2024
1	202	15-10-2024	30-10-2024

Step 4: Third Normal Form (3NF)

In the Third Normal Form (3NF), we remove any transitive dependencies. Now, each table contains only data that is directly related to the primary key, with no transitive relationships.

Books Table (3NF):

BookID	BookTitle
1	Book A
2	Book B
3	Book C

Authors Table (3NF):

AuthorID	AuthorName

101	John Doe
102	Jane Roe
103	Mike Smith

Borrowers Table (3NF):

BorrowerID	BorrowerName
201	Alice
202	Bob
203	Charlie

Borrowing Transactions Table (3NF):

BookID	BorrowerID	BorrowDate	ReturnDate
1	201	01-10-2024	15-10-2024
2	202	05-10-2024	20-10-2024
3	203	10-10-2024	25-10-2024
1	202	15-10-2024	30-10-2024

Step 5: Fourth and Fifth Normal Form (4NF & 5NF)

In the Fourth and Fifth Normal Forms (4NF & 5NF), there are no multi-valued or complex join dependencies. Our tables are now in the final normalized form.

Conclusion

In this document, we explored the process of normalizing a Library Management System database through several steps of normalization. By applying 1NF, 2NF, 3NF, 4NF, and 5NF, we effectively reduced redundancy, improved data integrity, and organized the data into efficient and meaningful tables. This ensures that the system is optimized for storage, retrieval, and maintenance, avoiding anomalies and inconsistencies that arise from poorly structured databases.