

Normalization Process for the College Library Database

1. Overview

Normalization is a systematic approach to organizing data in a database to reduce redundancy and improve data integrity. The normalization process ensures that all relations are in **Third Normal Form (3NF)** by eliminating transitive and partial dependencies. Below are the steps taken to normalize the entities in the college library database.

2. Normalized Design

Member Entity

- **Original Table:**
 - The `MaxLoans` attribute is functionally dependent on `MemberType` rather than the primary key (`MemberID`). This violates 3NF.
 - **Normalization:**
 - Extract `MaxLoans` into a separate `MEMBER_TYPE` table with `MemberType` as the primary key.
 - **Normalized Tables:**
 - **MEMBER:** (`MemberID`{PK}, `Fname`, `Lname`, `Email`, `MemberType`, `AccountStatus`)
 - **MEMBER_TYPE:** (`MemberType`{PK}, `MaxLoans`)
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Resource Entity

- **Original Table:**
 - The attributes `Author`, `Creator`, `Director`, and `Musician` are multivalued, and `ClassName` is dependent on `ClassNumber`, which creates redundancy and violates 3NF.
- **Normalization:**
 - Separate multivalued attributes into individual tables (e.g., `BOOK_AUTHOR`, `VIDEO_CREATOR`) to achieve 1NF.
 - Extract `ClassName` into a separate `CLASS` table with `ClassNumber` as the primary key.
- **Normalized Tables:**
 - **RESOURCE:** (`ResourceID`{PK}, `Title`, `FloorNumber`, `ShelfNumber`, `ClassNumber`, `ISBN`, `LoanType`, `Format`)
 - **BOOK_AUTHOR:** (`ResourceID`{PK}{FK}, `Author`)
 - **VIDEO_CREATOR:** (`ResourceID`{PK}{FK}, `Creator`)
 - **DVD_DIRECTOR:** (`ResourceID`{PK}{FK}, `Director`)
 - **CD_MUSICIAN:** (`ResourceID`{PK}{FK}, `Musician`)

- **CLASS:** (ClassNumber{PK}, ClassName)
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Copy Entity

- **Original Table:**
 - The attribute Availability depends on ResourceID and CopyNumber.
 - **Normalization:**
 - The table is already in 3NF, as all attributes are fully functionally dependent on the composite primary key (ResourceID, CopyNumber).
 - **Normalized Table:**
 - **COPY:** (ResourceID{FK}, CopyNumber{PK}, Availability)
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Loan Entity

- **Original Table:**
 - The table has no violations, but derived attributes like DueDate and OverdueDays are calculated and not stored.
 - **Normalization:**
 - Retain the structure but document derived attributes separately.
 - **Normalized Table:**
 - **LOAN:** (LoanNumber{PK}, MemberID{FK}, ResourceID{FK}, CopyNumber{FK}, IssueDate, ReturnDate)
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Reservation Entity

- **Original Table:**
 - The table is in 1NF but includes derived attributes like ReservationStatus and RemainNotifications.
 - **Normalization:**
 - Retain the structure but ensure derived attributes are only calculated and not stored.
 - **Normalized Table:**
 - **RESERVATION:** (ReservationNumber{PK}, MemberID{FK}, ResourceID{FK}, ReservationDate, ReservationStatus, RemainNotifications)
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Notification Entity

- **Original Table:**

- The table contains `OfferValidityDate` and `Status`, which are derived attributes.
 - **Normalization:**
 - Retain the structure but calculate derived attributes on-demand.
 - **Normalized Table:**
 - **NOTIFICATION:** (`NotificationNumber`{PK}, `MemberID`{FK}, `ReservationNumber`{FK}, `NotificationDate`)
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Fine Entity

- **Original Table:**
 - The table includes `FineAmount`, which is a derived attribute based on overdue days and the daily fine rate.
 - **Normalization:**
 - Retain the structure but calculate `FineAmount` on-demand.
 - **Normalized Table:**
 - **FINE:** (`FineID`{PK}, `MemberID`{FK}, `LoanNumber`{FK}, `FineAmount`)
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Payment Entity

- **Original Table:**
 - The table is already in 3NF, with no redundant attributes or dependencies.
 - **Normalized Table:**
 - **PAYMENT:** (`PaymentID`{PK}, `MemberID`{FK}, `PaymentDate`, `PaymentAmount`)
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3. Summary of Normalization

The normalization process ensured the following:

1. Eliminated multivalued attributes (e.g., `Author`, `Creator`) by creating separate tables.
2. Removed transitive dependencies (e.g., `ClassName` and `MaxLoans`) by creating separate relations like `CLASS` and `MEMBER_TYPE`.
3. Derived attributes (e.g., `DueDate`, `FineAmount`) were documented but excluded from stored tables, ensuring normalization to 3NF.