# Library Management System Database Design and Specification

14.01.2024

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# Table Of Contents

**Table Of Contents** ..... **1**
**Intro** ..... **2**
**I. Intro and Mission Statement** ..... **2**
**II. Objectives and System Definition** ..... **2**
**Conceptual** ..... **3**
**I. Entities** ..... **3**
**II. Attributes** ..... **3**
- Manager ..... 3
- Customer ..... 3
- Books ..... 4
- Checkout ..... 4
- BookCopies ..... 4
- Author ..... 4

**III. Relationships - Cardinanlity** ..... **4**
**IV. Use Case Diagram - Library Management System** ..... **5**
**V. E-R Diagram** ..... **6**
**VI. Data Dictionary** ..... **6**
Author ..... 6
Indexes ..... 6
Book ..... 7
Indexes ..... 7
BookCopies ..... 7
Indexes ..... 7
Checkouts ..... 8
Indexes ..... 8
Customer ..... 8
Indexes ..... 8
Manager ..... 9
Indexes ..... 9
Author ..... 9
Indexes ..... 9
Book ..... 10
Indexes ..... 10
BookCopies ..... 10

Indexes....10
Checkouts....11
Indexes....11
Customer....11
Indexes....11
Manager....12
Indexes....12
**Logical....12**
**I. Normalisation Process....12**
First Normal Form....12
Second Normal Form....12
Third Normal Form....13
**Physical....13**
**I. Transaction Analysis....13**
**II. User Views....14**
Manager....14
Customer....14
**III. Process and Major Decisions....14**

# Intro

## I. Intro and Mission Statement

A. For this assessment, I have been assigned the task of creating specifications for a database we will later implement. We were also given the freedom to choose the topic for our database to be built on. I have gone with a Library Management System as I felt it would be a complex task that would be reasonable for a single person to implement. My mission with this task is to create a system and database that could be implemented into a library to help manage their inventory as well as give the customer in the library the ability to view the books and their details.

## II. Objectives and System Definition

A. This library management system can be used by employees/managers in a library to handle the customers checkouts as well as the library's inventory. The services provided are book checkout and return for the customer when performed by a manager and inventory information management by the manager. After a successful login, the manager will be able to edit the inventory of the library, make checkouts and returns for the customer, and

view the checkouts that have been made as well as their status. The main use of this library management system is to help the manager manage the business and its inventory.

# Conceptual

## I. Entities

- MANAGER
- CUSTOMER
- BOOKS
- AUTHOR

## II. Attributes

- Manager
  - Manager_id
  - Fname
  - Lname
  - User_name
  - Password
- Customer
  - Customer_id
  - Name
  - Email
  - Street
  - Registration_date
  - City
- Books

- ISBN
- Title
- Category
- Rental_price
- Author
- available_copies

- **Checkout**
  - Checkout_id
  - Start_time
  - End_time
  - Book_ISBN
  - Customer_id
  - is_returned

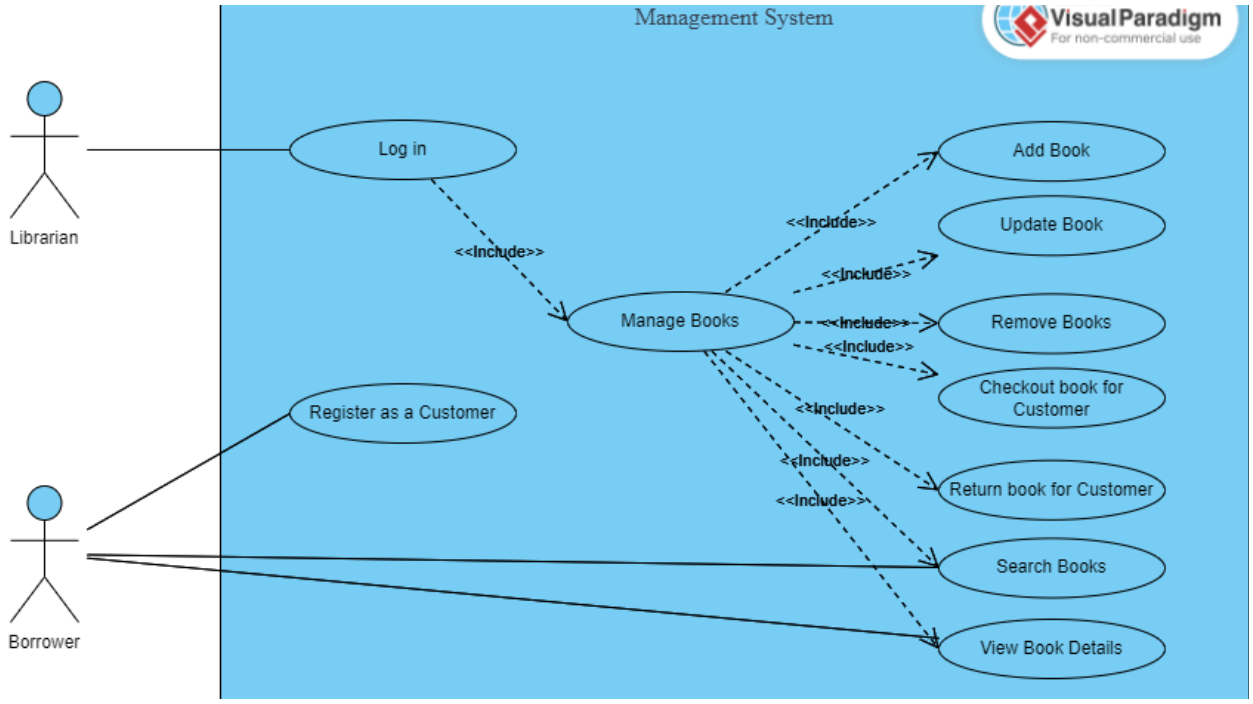
- **BookCopies**
  - Copy_id
  - Book_ISBN
  - is_available

- **Author**
  - Author_id
  - Name

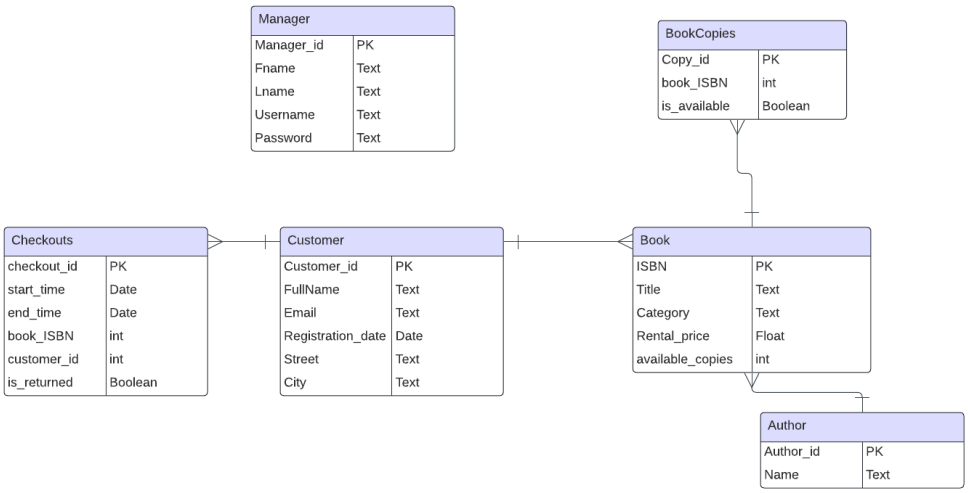
## III. Relationships - Cardinality

- MANAGER updates, removes, or adds books (1 - N)
- CUSTOMER creates account (N - 1)
- CUSTOMER checks out books (1 - N)
- CUSTOMER returns books (1 - N)

# IV. Use Case Diagram - Library Management System



# V. E-R Diagram




# VI. Data Dictionary

## Author

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| Author_id (Primary) | int | No | | | |
| Name | varchar(255) | No | | | |

## Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | Author_id | 26 | A | No | |

## Book

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| ISBN (Primary) | int | No | | | |
| Title | varchar(255) | No | | | |
| Category | varchar(255) | No | | | |
| Rental_price | decimal(10,2) | No | | | |
| Author_id | int | No | | Author -> Author_id | |
| available_copies | int | No | 10 | | |

### Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | ISBN | 27 | A | No | |
| Author_id | BTREE | No | No | Author_id | 23 | A | No | |

## BookCopies

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| Copy_id (Primary) | int | No | | | |
| book_ISBN | int | No | | Book -> ISBN | |
| is_available | tinyint(1) | Yes | NULL | | |

### Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null |
|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | Copy_id | 134 | A | No |
| BookCopies_ibfk_1 | BTREE | No | No | book_ISBN | 26 | A | No |

## Checkouts

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| checkout_id (Primary) | int | No | | | |
| start_time | date | No | | | |
| end_time | date | No | | | |
| book_ISBN | int | No | | Book -> ISBN | |
| customer_id | int | No | | Customer -> Customer_id | |
| is_returned | tinyint(1) | No | | | |

### Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | checkout_id | 3 | A | No | |
| Checkouts_ibfk_2 | BTREE | No | No | customer_id | 2 | A | No | |
| book_ISBN | BTREE | No | No | book_ISBN | 3 | A | No | |

## Customer

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| Customer_id (Primary) | int | No | | | |
| FullName | varchar(50) | No | | | |
| Email | varchar(100) | No | | | |
| Street | varchar(255) | No | | | |
| Registration_date | date | No | | | |
| City | varchar(255) | No | | | |

### Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | Customer_id | 2 | A | No | |

## Manager

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| Manager_id (Primary) | int | No | | | |
| Fname | varchar(30) | No | | | |
| Lname | varchar(50) | No | | | |
| Username | varchar(20) | No | | | |
| Password | varchar(20) | No | | | |

### Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | Manager_id | 2 | A | No | |

## Author

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| Author_id (Primary) | int | No | | | |
| Name | varchar(255) | No | | | |

### Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | Author_id | 26 | A | No | |

## Book

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| ISBN (Primary) | int | No | | | |
| Title | varchar(255) | No | | | |
| Category | varchar(255) | No | | | |
| Rental_price | decimal(10,2) | No | | | |
| Author_id | int | No | | Author -> Author_id | |
| available_copies | int | No | 10 | | |

### Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | ISBN | 27 | A | No | |
| Author_id | BTREE | No | No | Author_id | 23 | A | No | |

## BookCopies

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| Copy_id (Primary) | int | No | | | |
| book_ISBN | int | No | | Book -> ISBN | |
| is_available | tinyint(1) | Yes | NULL | | |

### Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | Copy_id | 134 | A | No | |
| BookCopies_ibfk_1 | BTREE | No | No | book_ISBN | 26 | A | No | |

## Checkouts

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| checkout_id (Primary) | int | No | | | |
| start_time | date | No | | | |
| end_time | date | No | | | |
| book_ISBN | int | No | | Book -> ISBN | |
| customer_id | int | No | | Customer -> Customer_id | |
| is_returned | tinyint(1) | No | | | |

### Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | checkout_id | 3 | A | No | |
| Checkouts_ibfk_2 | BTREE | No | No | customer_id | 2 | A | No | |
| book_ISBN | BTREE | No | No | book_ISBN | 3 | A | No | |

## Customer

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| Customer_id (Primary) | int | No | | | |
| FullName | varchar(50) | No | | | |
| Email | varchar(100) | No | | | |
| Street | varchar(255) | No | | | |
| Registration_date | date | No | | | |
| City | varchar(255) | No | | | |

### Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | Customer_id | 2 | A | No | |

### Manager

| Column | Type | Null | Default | Links to | Comments |
|---|---|---|---|---|---|
| Manager_id (Primary) | int | No | | | |
| Fname | varchar(30) | No | | | |
| Lname | varchar(50) | No | | | |
| Username | varchar(20) | No | | | |
| Password | varchar(20) | No | | | |

Indexes

| Keyname | Type | Unique | Packed | Column | Cardinality | Collation | Null | Comment |
|---|---|---|---|---|---|---|---|---|
| PRIMARY | BTREE | Yes | No | Manager_id | 2 | A | No | |

# Logical

## I. Normalisation Process

### First Normal Form

1NF requires each column to have its own values which my tables did upon first creation.

### Second Normal Form

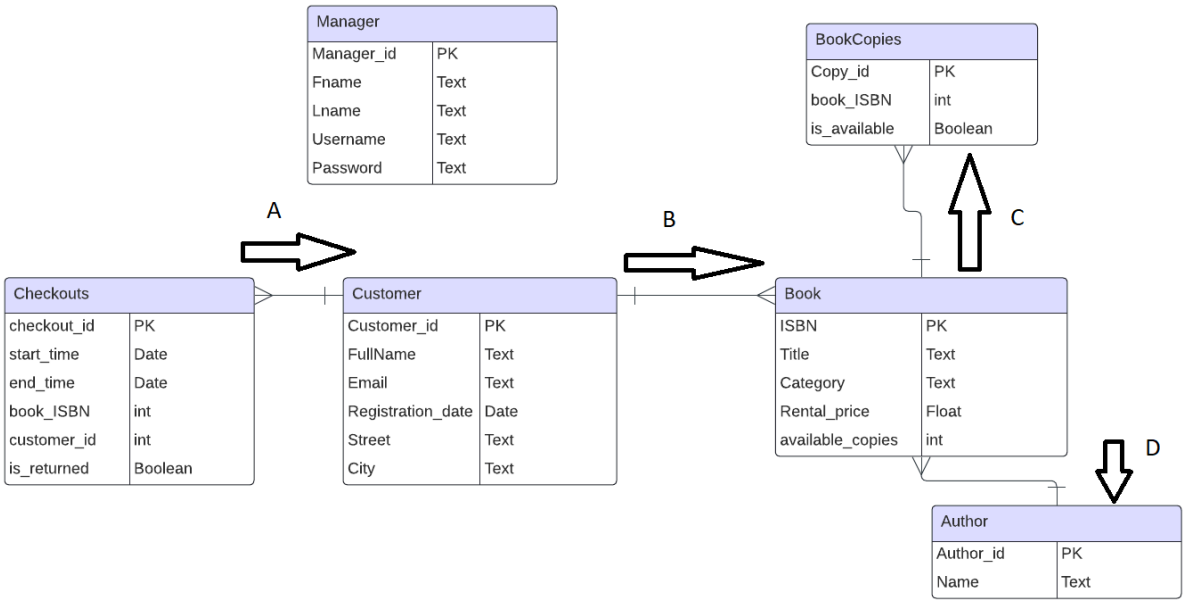
2NF requires the tables to be in 1NF and not have any non-prime attribute that is functionally dependent on any proper subset of any candidate key of the relation. This was a bit tricky because originally I had the author's name in the book category but then I realized I needed a separate table to be in second normal form so I created a table with author_id which and the authors name. I also had to separate the address into Street and City in the customer table.

### Third Normal Form

3NF requires the tables to be 1NF, 2NF, and have no non-prime attribute of R is transitively dependent on the primary key. This is where I created the BookCopies table so the amount of copies available so that the book table didn't have a column that was transitively dependent on a primary key.

# Physical

## I. Transaction Analysis




| Transaction/Relation | | A | | | | | B | | | | | B | | | | | D | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | R | U | D | | C | R | U | D | | C | R | U | D | | C | R | U | D |
| Manager | X | X | X | X | | X | X | X | X | | X | X | X | X | | X | X | X | X |
| Customer | | | | | | X | | | | | | X | | | | | | | |

# II. User Views

## Manager

- As a manager: I should be able to create, update, edit, and delete books from my inventory.
- As a manager: I should be able to see which customers have borrowed books and which books they have borrowed.

## Customer

- As a customer: I should be able to view the books available
- As a customer: I should be able to register as a borrower

# III. Process and Major Decisions

To start this project, I first came up with a rough idea about how I wanted the database to function. I wanted it to function as a way for a manager/employee at a physical library to be able to keep track of the inventory of their library. I could have done an online book store but that seemed to me to be something that already exists a lot online. Furthermore, I wanted this database to be something a small library or even somebody with a large collection of books could implement to make keeping track of their inventory easier than doing it manually. Once I had decided on the goals of my database, I then started to create diagrams such as the use case diagram to visualize how the database would function. The next step was creating the tables and normalising them. As described above, this didn't cause me too much trouble but it did take some thinking despite my planning with the UML diagrams. Finally, I had to think about what I wanted each type of user to be able to do so I created the transaction tableand defined the user views. This has all led to me being confident I will be able to successfully implement this system efficiently and effectively.