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System Architecture, Design Decisions & Assumptions

This project is developed and designed in IntelliJ IDEA 2023.2.3 (Ultimate Edition) for the backend, Visual Studio Code for the frontend and the database management system is handled by MySQL Workbench. The Library Management System application developed uses Angular Framework for Front End, Spring Boot for Backend and MySQL for database management. Also used Python for creation of database and parsing and pushing data into the tables created. The project uses java version "21.0.1", jdk version 21, Angular CLI version "13.1.2" and Node version "14.17.5".

 The tables used for the project are:

1. BOOK
2. BOOK_AUTHORS
3. AUTHORS
4. BORROWER
5. BOOK_LOANS
6. FINES

The schema for the tables was as follows:
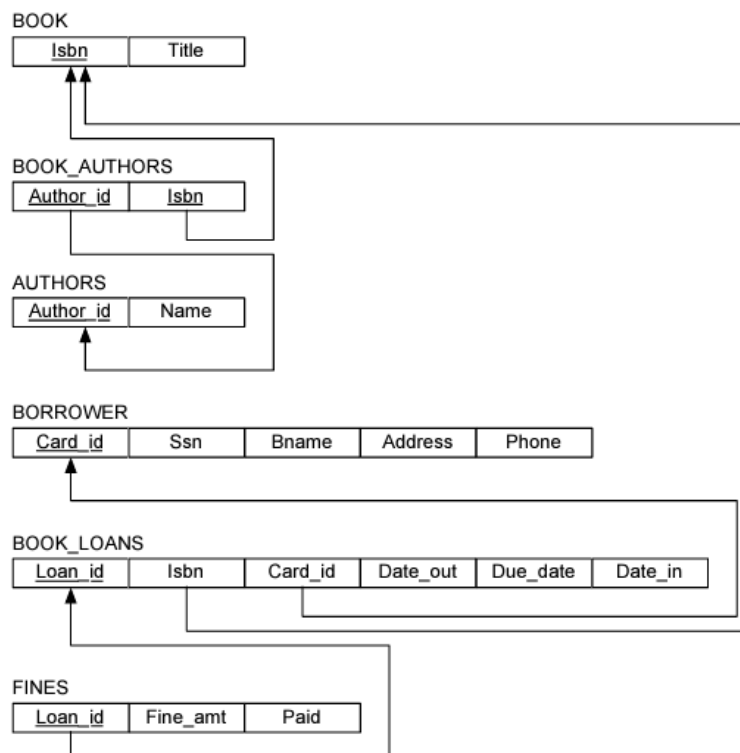
The relationships between each of the foreign references between the tables were assumed as follows and the database was designed accordingly:

BOOK -BOOK_AUTHORS – <u>Many to Many Relationship</u> (Since each record in BOOK table can have multiple records in BOOK_AUTHORS table and vice versa)

BOOK_AUTHORS-AUTHORS – <u>Many to Many Relationship</u> (Since each record in BOOK_AUTHORS table can have multiple records in AUTHORS table and vice versa)

BOOK - BOOK_LOANS – <u>One to Many Relationship</u> (Since each record in BOOK table can have multiple records in BOOK_LOANS table and many records in BOOK_LOANS table point to one record in BOOK table)

BOOK_LOANS – BORROWER – <u>Many to One Relationship</u> (Since many records in BOOK_LOANS table point to one record in BORROWER table and one record in BORROWER point to many records in BOOK_LOANS table)

FINES - BOOK_LOANS – <u>One to One Relationship</u> (Since each record in FINES table can have only one record it points to in BOOK_LOANS table and vice versa)

<u>Diagram from the SQL Workbench:</u>
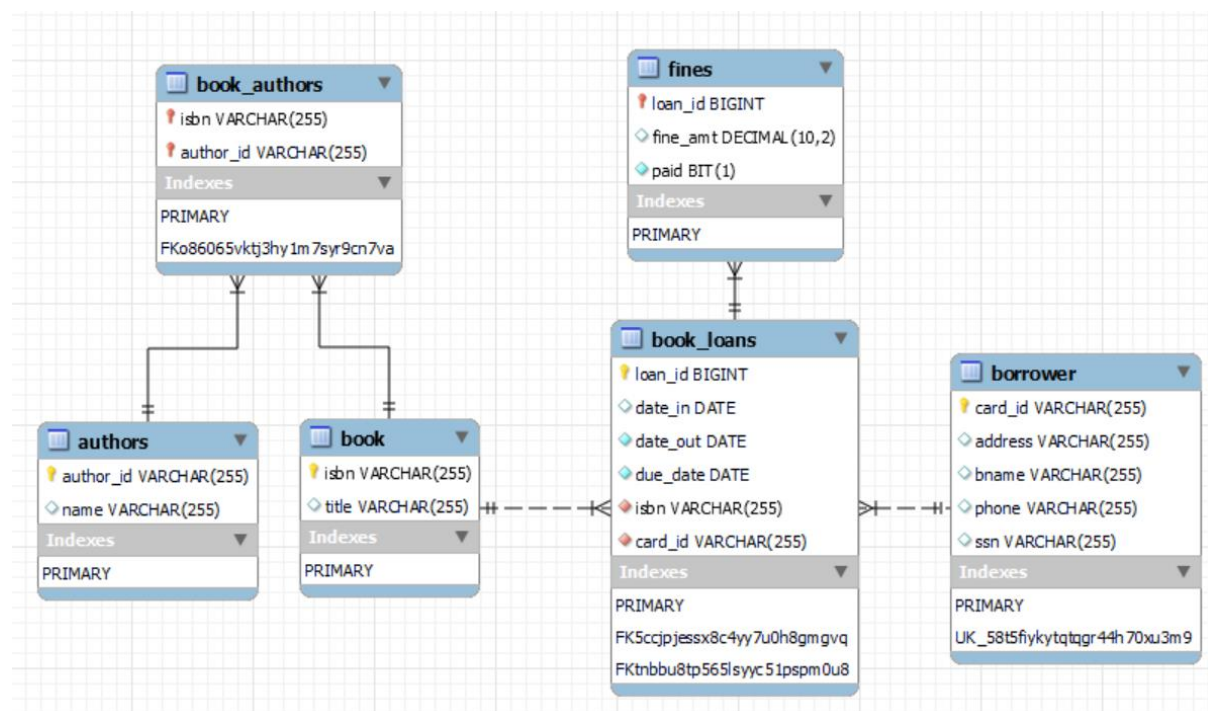
Assumptions regarding the design of the project:

- Each borrower can check out a maximum of 3 books either at different times or at a time.
- Each borrower has a unique SSN.
- The records in Fines table can be created in only two ways:

a) While any book is checked in, records will be updated in the BOOK_LOANS table and if it is to be fined for late check in, a new record will be added in the FINES table.

b) If a book is still out (Not checked in yet) and the due date is already past, record will be created in the FINES table when clicked Refresh button on the Refresh fines page only.

Functionality of each page (Along with CRUD operations performed in DB):

Home Page:

- On this page, find the functionality of each page and click any of the buttons that navigates to the respective pages connected with component links.
- The application also has a navbar that links to all the pages as well.

Search Book by any substring

- On this page, search with any substring of the book title, author name or isbn and click Search button. It will show all the records with the current availability of that book. It will search the records from BOOK, BOOK_LOANS, AUTHORS and BOOK_AUTHORS tables by joining them.
- According to the availability of the book, the checkbox will be disabled.
- Click the desired checkboxes and click the Add to Check Out button to check the books out.
- Go to Check Out button will navigate to the checkout page to issue the books selected.

Search Book by ISBN

- In this page, search with any substring of the book's isbn and click Search button. It will show all the records with the current availability of the books. It will search the records from BOOK, AUTHORS, BOOK_LOANS and BOOK_AUTHORS tables by joining them.
- According to the availability of the book, the checkbox will be disabled.
- Click the desired checkboxes and click the Add to Check Out button to check the books out.
- Go to Check Out button will navigate to the checkout page to issue the books selected.

Check In:

- In this page, type in any substring of the book's isbn, Borrower's Card ID, or any substring of Borrower's name. and click Search button. It will show all the records of the current checked out books.

- Click check in box for the book you want to check in and it will update records in the BOOK_LOANS table with date_in as the date of checked in.
- It will check if the book was overdue and create records in the Fines table accordingly with the fine amount.

Check Out:

- In this page, Re-confirm the books you require to check out and click the delete button for the ones you don't want to issue.
- Enter the card ID of the borrower who wants to issue the books and click Check out button below the records to issue the books. This will create new records in the BOOK_LOANS table and set Date_Out as the current date , Due Date as 14 days from Current date and Date_In as null.
- If the borrower tries to check out more than 3 books, the system will throw an error and not issue the books out.

Add Borrower

- In this page, fill in all the details of the new borrower to be added and click Add Borrower button in the end.
- It will generate a unique Card ID of the existing format for each borrower added.
- Adding Users with same/duplicate SSN will not be allowed, system will throw an error and not add the borrower.

Refresh Fines

- In this page, click on the Refresh fines button to refresh all the fines of the books that haven't been checked in yet.
- It will fetch data from BOOK_LOANS table and FINES table and update the fines records by checking for Book not Check in condition.

Pay Fine

In this page, you have two options:

1) Display All Fines for all Borrowers
- Clicking this button will display all the fines for all the existing borrowers of the books that been created. It will calculate all the pending Fines for each borrower by fetching the data from BOOK_LOANS table, BORROWERS table and FINES table and display in each of the records of the displayed table.
2) Display and Pay Fine for Borrower
- Clicking this button will prompt you to enter the Card ID of the borrower and it will then show all the Pending Fines along with the due date, date in and date out of the

books. It will do so by fetching the data from BOOK_LOANS table, BORROWERS table and FINES table where Date In is not set.

- It will also show the total Pending fine amount for the books that have checked in and a button for paying off those pending fines. This button will pay the fines of the book by updating the records in the FINES table.
- It will also show all the previously paid fines of the borrower by fetching the data from BOOK_LOANS table, BORROWERS table and FINES table where Fines were paid.