Designing simple web Application in Spring Boot

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Before we start ...

Kinga

- Participated in Women In Tech Camp in 2017 , where decided to apply for internships at Ericsson,
- Now works as Senior Software Developer responsible of automation in one of Ericsson's QAs,
- Main technology used at work: Java.

Łukasz

- Has been working at Ericsson for 9 years,
- Senior Software Developer responsible of automation in one of Ericsson's QAs,
- Main technology used at work: Java.

Content of presentation

1 Functional specification

- General Info
- Roles
- Items/Objects in System
- Use Cases
- Scenarios
- Limitations
- Forms/Views

2 Implementation - Backend

- Technologies used
- Spring Boot – what is it?
- Database schema
- Database – Hibernate & MySQL
- REST methods
- Spring Security

3 View - Frontend

- Technologies used
- Thymeleaf
- Bootstrap
- JQuery

4 Questions

GitHub

- In case if you will be interested in topic after this training
– you can find Presentations and Application on GitHub

- https://github.com/lukaszkutrz/my_first_app_in_springboot

- Presentations and code will be updated till the end of this week
(I ve just invented some new ideas of small improvements)

- Source code of application Book Rental,

- Additional presentation describes how to configure environment and run the application,

1 Functional specification

General information

Book Rental is a web application written using Spring Boot, Hibernate & Thymeleaf.

Book Rental is designed for librarians, and it is supposed to be used in small libraries. It helps with managing the process of renting books to readers.

Application is designed to be simple and not complicated. Many features are simplified.

- Before we start designing technical aspects of our application, we need to get to know our system.

- We need to think about what our program should do.

- We need to think about real-world problems that are supposed to be solved by our app.

- Without gaining the knowledge about the domain our application will not be effective!

User Roles

Librarian

Reader

Librarian

Librarian

- Registering the new users,
- Adding new books,
- Editing data about books / readers,
- Renting books to users,
- Checking how many books are rented by particular user,
- Handling returned books in system.

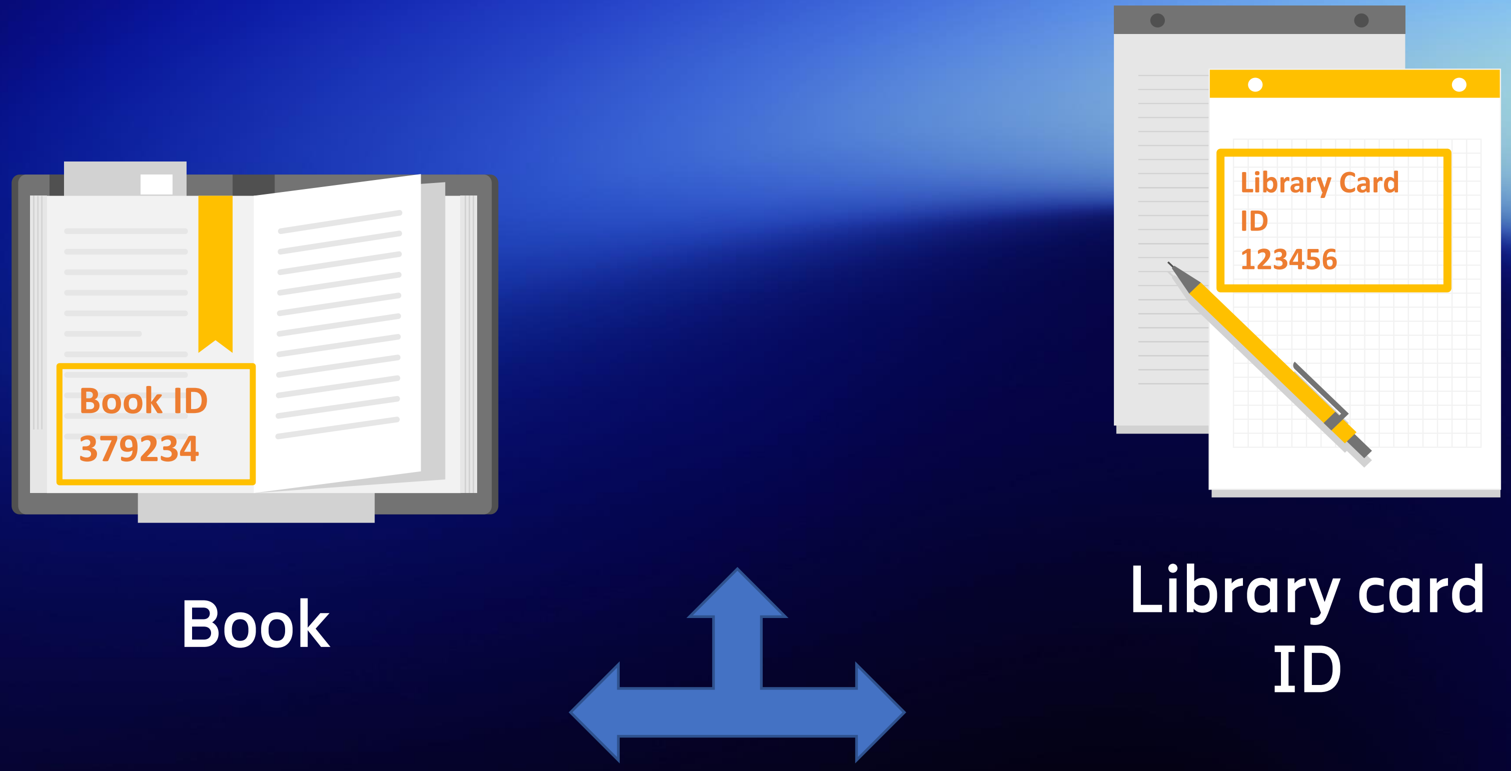
Reader

Reader

- Searches available books in Library,
- Checks which books are currently rented by him.

Items / Objects in system

Real—world objects



Book

Library card
ID

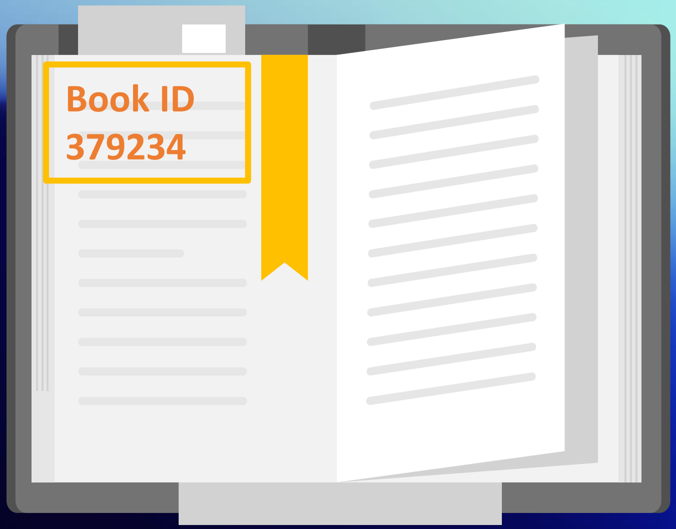
RENTED

Book

- Usually inside any library we have many books on the shelves,

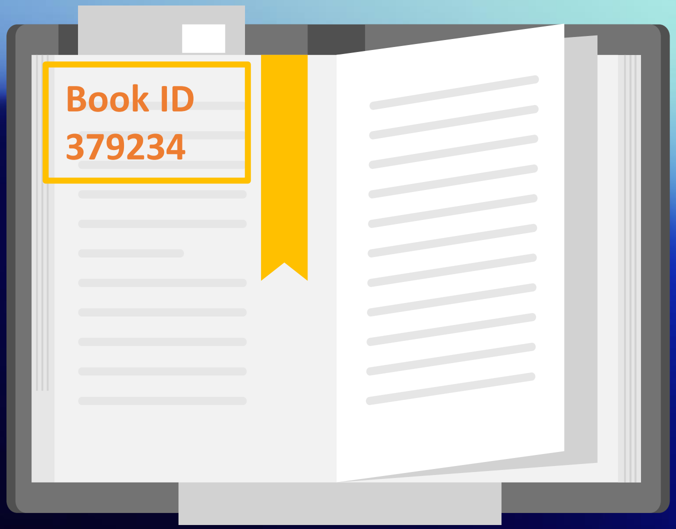
- Each book **has unique book ID**,

- Each book has **title** and **author.**



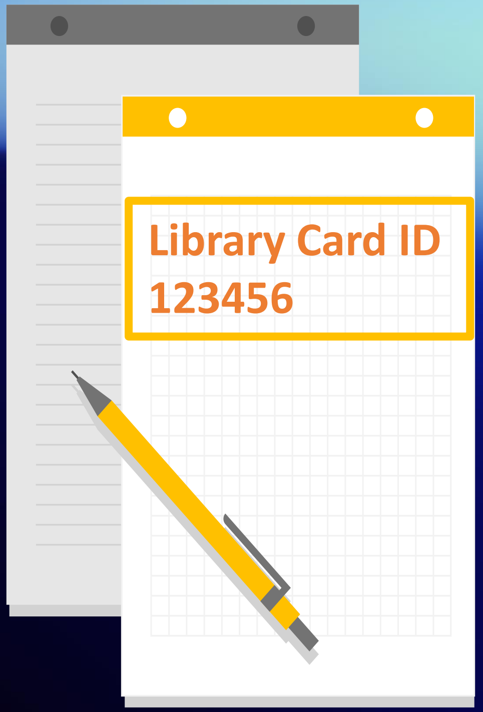
Book

- Other important properties are **ISBN** and **year of publication**,
- Book can have a few **categories** (for example: novel, romance, horror, fantasy, science-fiction…),
- Finding a particular book in big store might be difficult. To help Librarians with this task we added field **shelf**. This field represents physical location of book in library building.

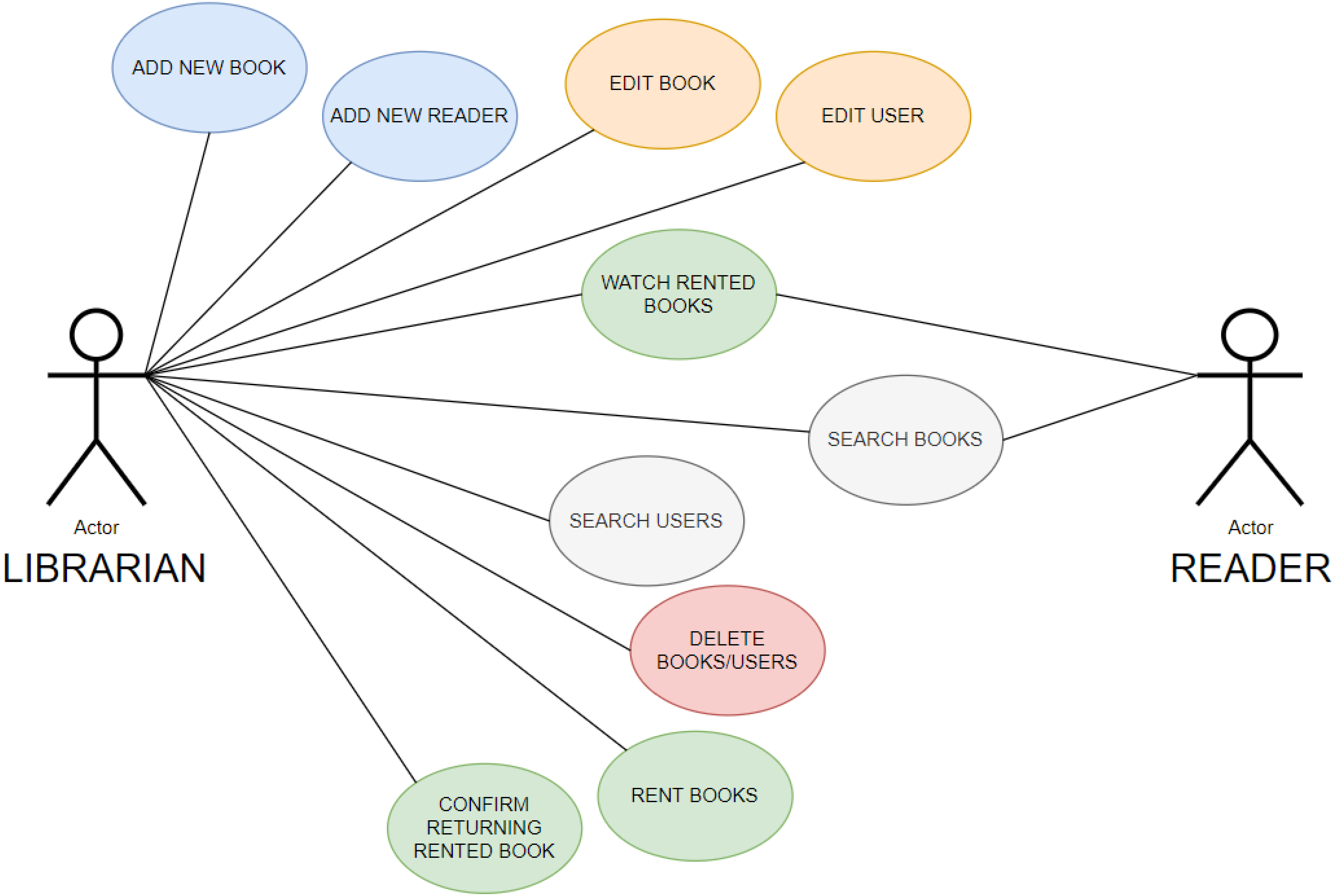


Library card

- Each user registered in library gets the printed document: “Library Card”,
- Each Library CARD has **unique ID**,
- The same ID is used in our system. Book Rental application identifies users by Library CARD ID.



Use cases


ADD NEW BOOK
ADD NEW READER
EDIT BOOK
EDIT USER
WATCH RENTED BOOKS
SEARCH BOOKS
SEARCH USERS
DELETE BOOKS/USERS
RENT BOOKS
CONFIRM RETURNING RENTED BOOK
Actor
LIBRARIAN
Actor
READER

Scenarios

Yellow – activities in "real world", for example putting book on the shelf

White – virtual activities in Book Rental application

Scenario 1: Library bought a new book

<<INSIDE LIBRARY>>

Librarian

- Librarian puts the new book on the shelf.
- Librarian starts the Book Rental application, logs in and clicks "Add New Book" button.
- Librarian fills in the form and confirms operation. Book is added to the system.

Scenario 2: New reader came to the library

<<INSIDE LIBRARY>>

Reader

- New Reader arrived. The person wants to join library.
- Librarian starts the Book Rental application, logs in and fills in the form “Add New User”. Unique ID is generated.
- Library CARD ID is printed by Librarian. Document is given to the user.

Librarian

Scenario 3: Reader wants to rent a book

<<INSIDE LIBRARY>>

Reader

- Reader comes in into the library building. Guest informs librarian about the book he wishes to rent.
- Librarian searches book in System. The book is available.
- Librarian takes the book from the shelf.
- Librarian registers renting book in the system using ID of Library CARD showed by user.

Librarian

Scenario 4: Reader comes to library and returns book

<<INSIDE LIBRARY>>

Reader

- Reader comes in into the library building and returns the book.
- Librarian searches book in System and registers that the book is back.
- Librarian puts the book on the shelf.
- From now on other readers might borrow this book.

Librarian

Scenario 5: Pile of returned books, readers already left

<<INSIDE LIBRARY>>

- In the morning many readers came to the library building. Librarian was very busy...
- In meanwhile a few readers put their books on the table and left the library.
- Now, we have a pile of returned books,
- One by one book, Librarian opens the books and finds the rubber stamp with book id,
- For each book librarian finds record in the system under "Rented Books" and clicks "Return Book" button

Librarian

Scenario 6: Reader logs in to Rental App from home,

<<ONLINE>>

Reader

- Reader needs certain book for his university work.
- Reader logs in to the system,
- Reader goes to "Search Book" and types the query.
- System displays the information about the desired book.
- Book is available in the library and not rented, so user will visit the building in person,

Limitations

Limitations

- Application can be used in libraries, so it is designed to be run on Laptops/Computers,
- Application **is NOT supposed** to be used on cell phones.

C

Limitations

- Application is designed to be simple and not complicated. Many features are simplified,

- Application was designed for <u>training purpose.</u>

- What is simplified?

- no registration and same password for each user with the same role

- no limit of books and no due date for rentals

Limitations – what is missing?

- **There should be a limit of books that could be rented by one user at a time** (also, zero books should exceeding the deadline). No renting possible for person that is breaking the rule.

- **Each rent should have the starting date and expected date of returning (30 days).** The return date for the rented the book can be postponed by Librarian.

- **Book Reservations by readers, they can be made online** – no need to arrive to library. Reserved book cannot be rented.

Limitations – what is missing?

- **Real login and registration handling**– so far, our application uses simplified login page with pre-defined passwords, roles for all users are granted on application start,

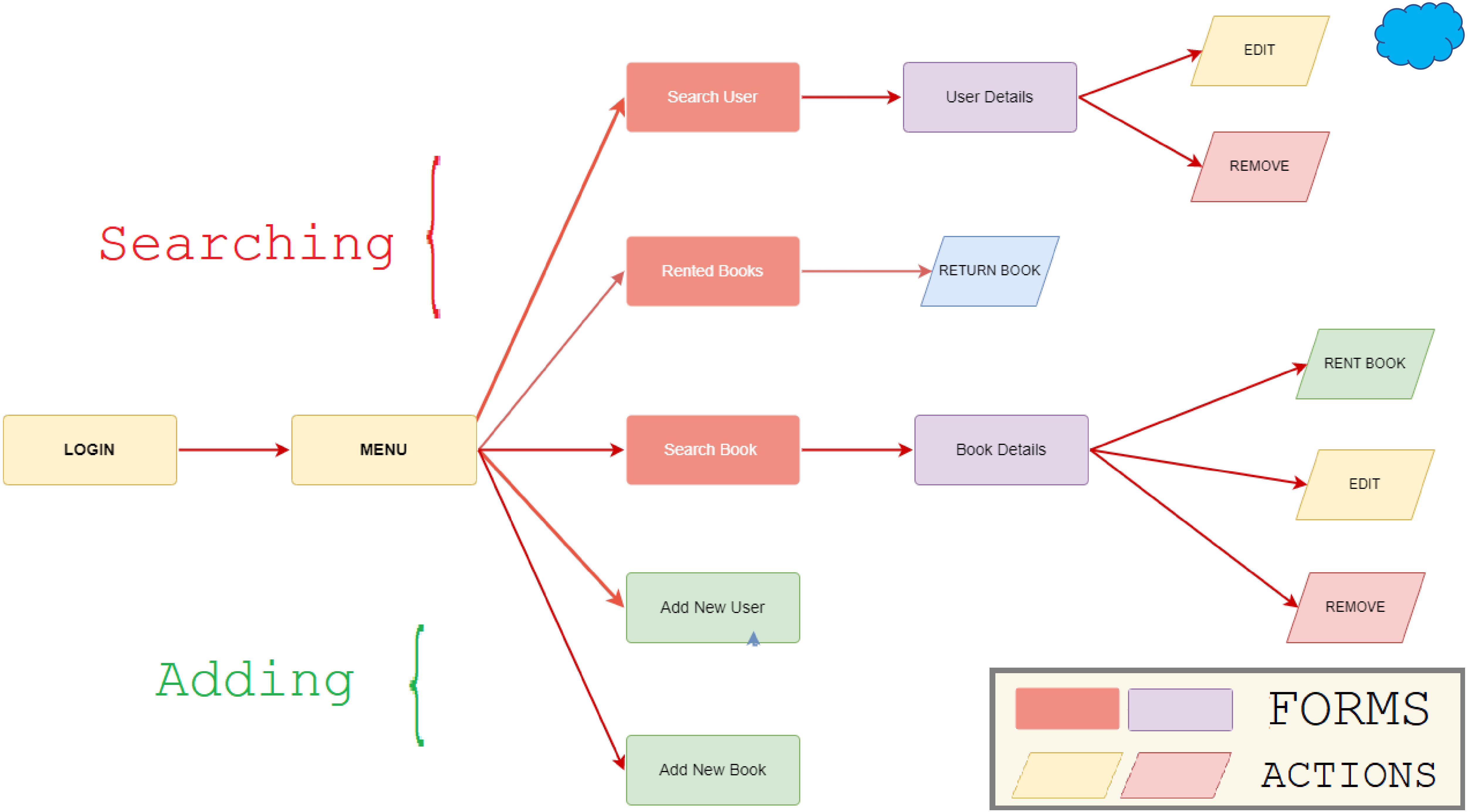
- **Users should be able to login to system immediately after they were added** (for now it requires the restart of application),

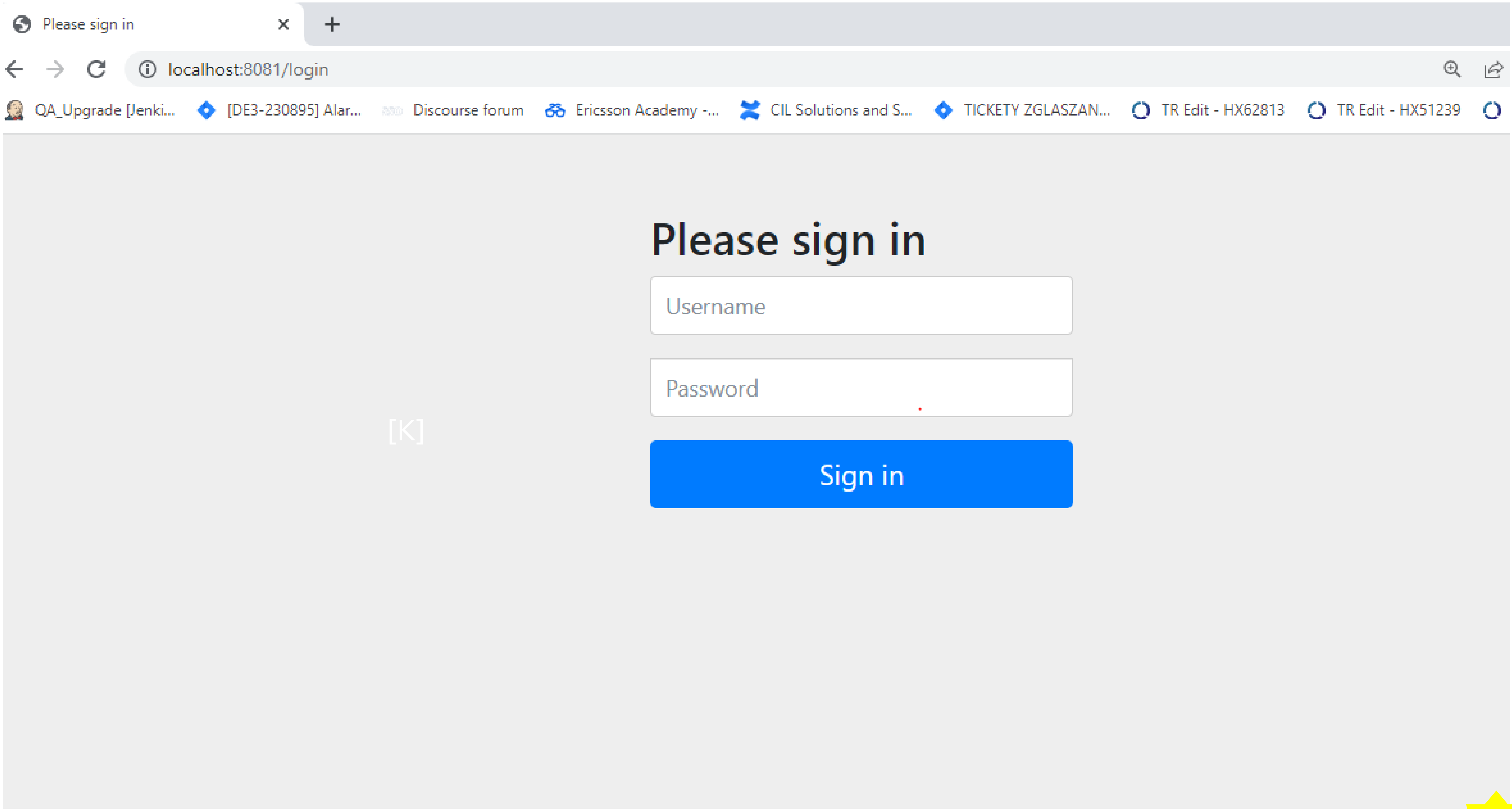
- **Lack of support for more than 1 copy of certain book** – user needs to add two or more identical books. This should be improved,

Forms / Views

- It is high time for designing the forms/subpages of our app,

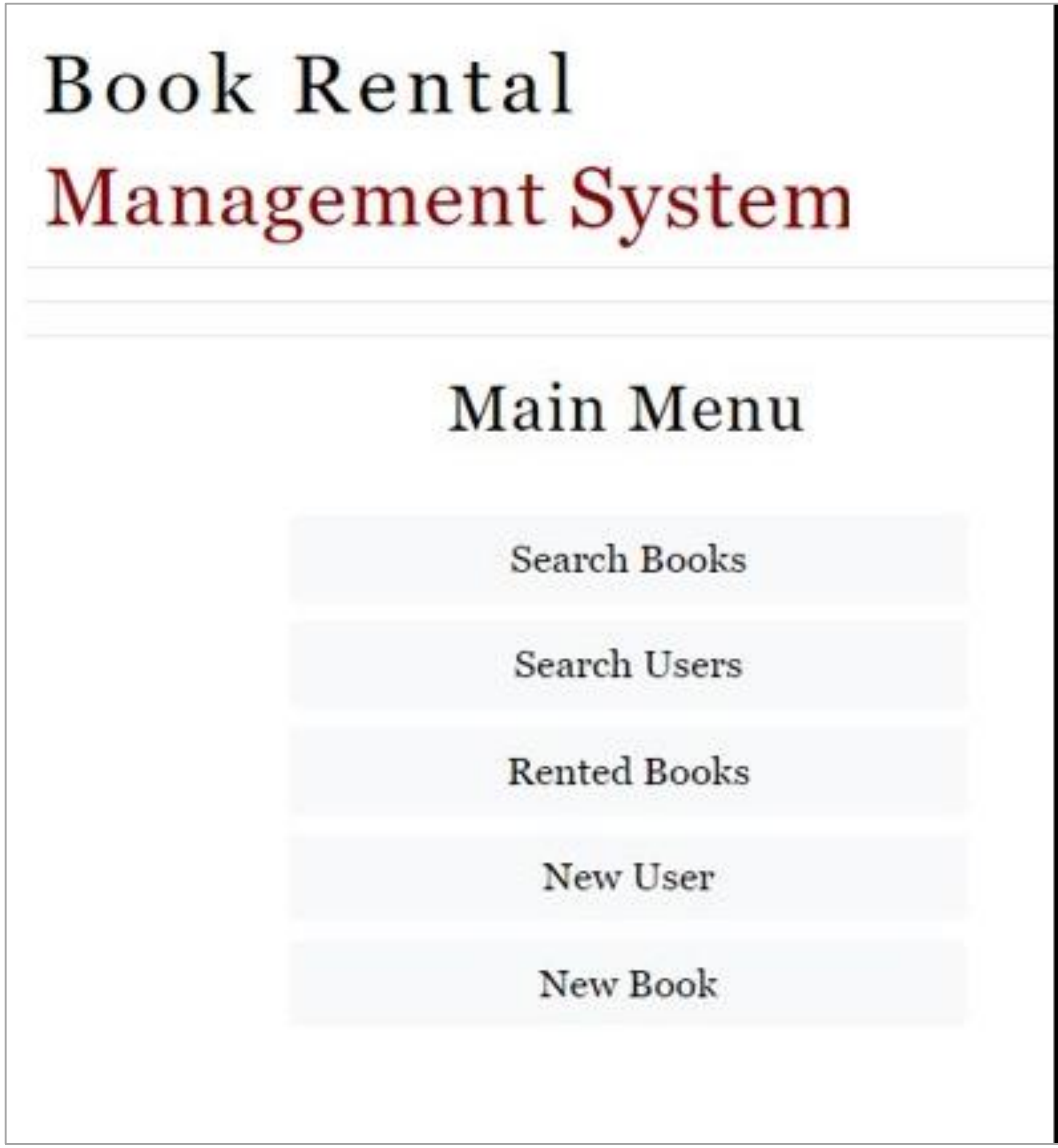
- To complete this task we can:
  - use **wireframing** (there are many applications on web that helps us with it),
  - or simply draw/sketch our forms on paper,

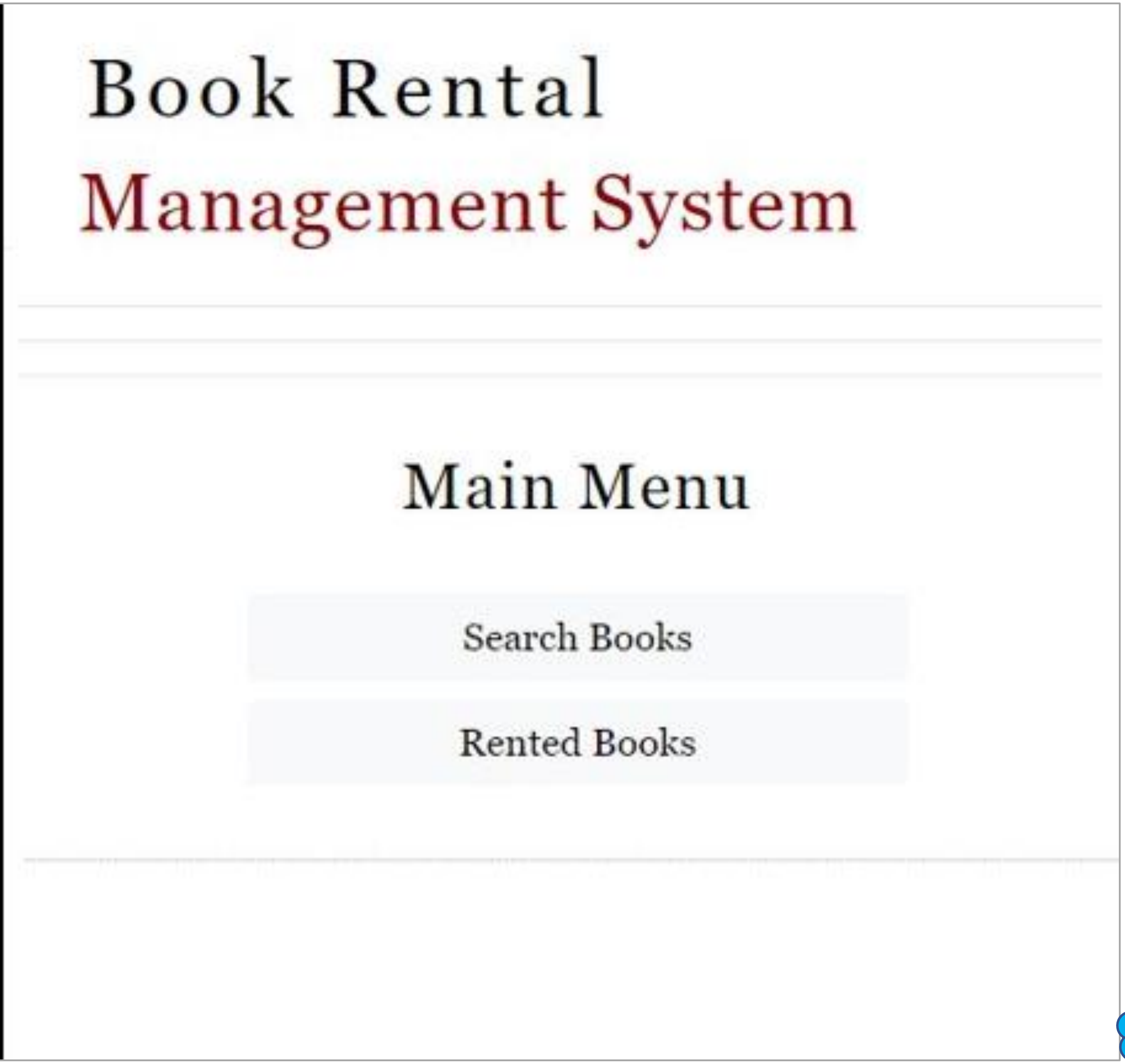

Searching
Adding
LOGIN
MENU
Search User
User Details
EDIT
REMOVE
Rented Books
RETURN BOOK
Search Book
Book Details
RENT BOOK
EDIT
REMOVE
Add New User
Add New Book
FORMS
ACTIONS

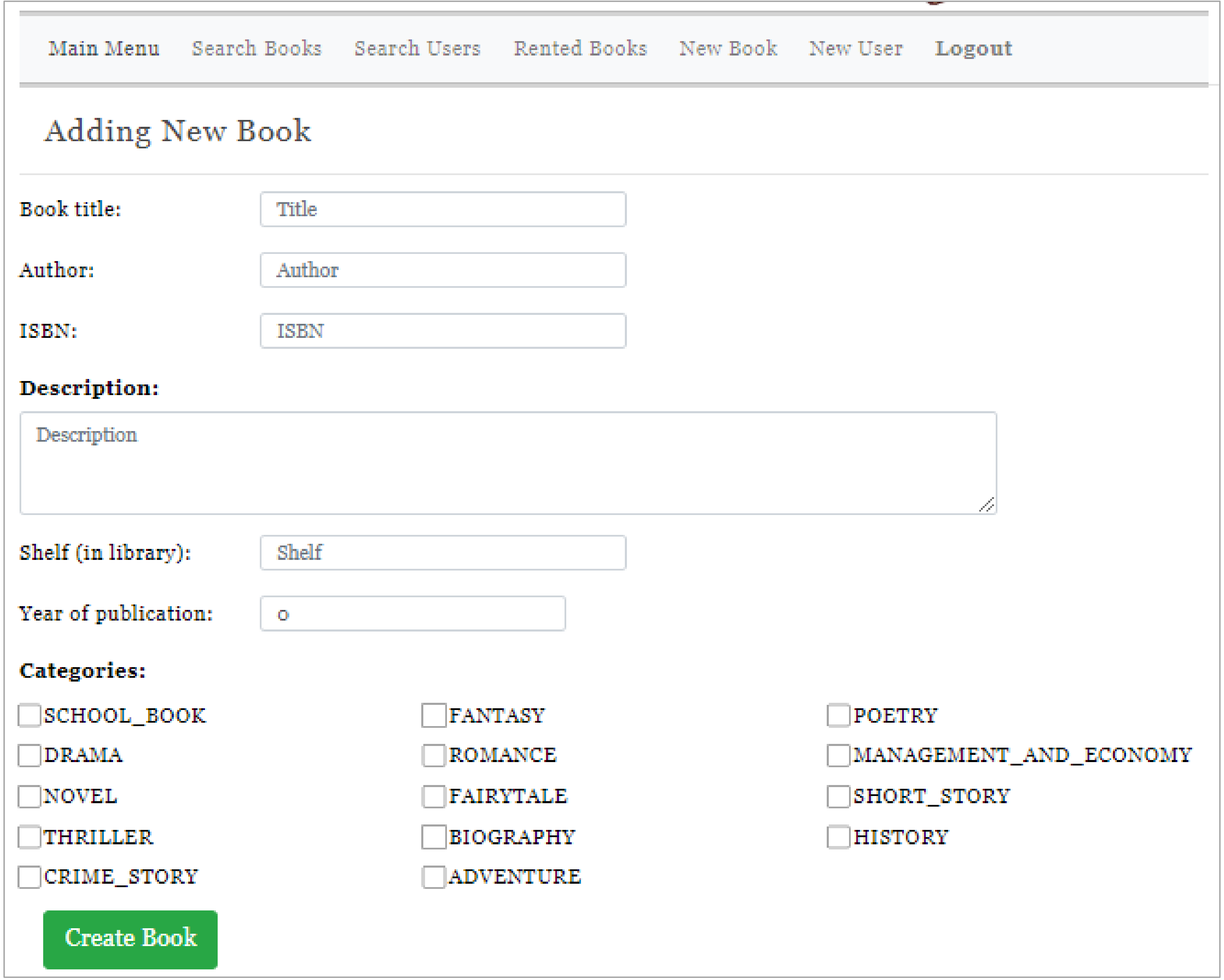


Please sign in

Menu for Librarian vs Menu for Reader







Adding New Book

Book title: Title

Author: Author

ISBN: ISBN

Description:

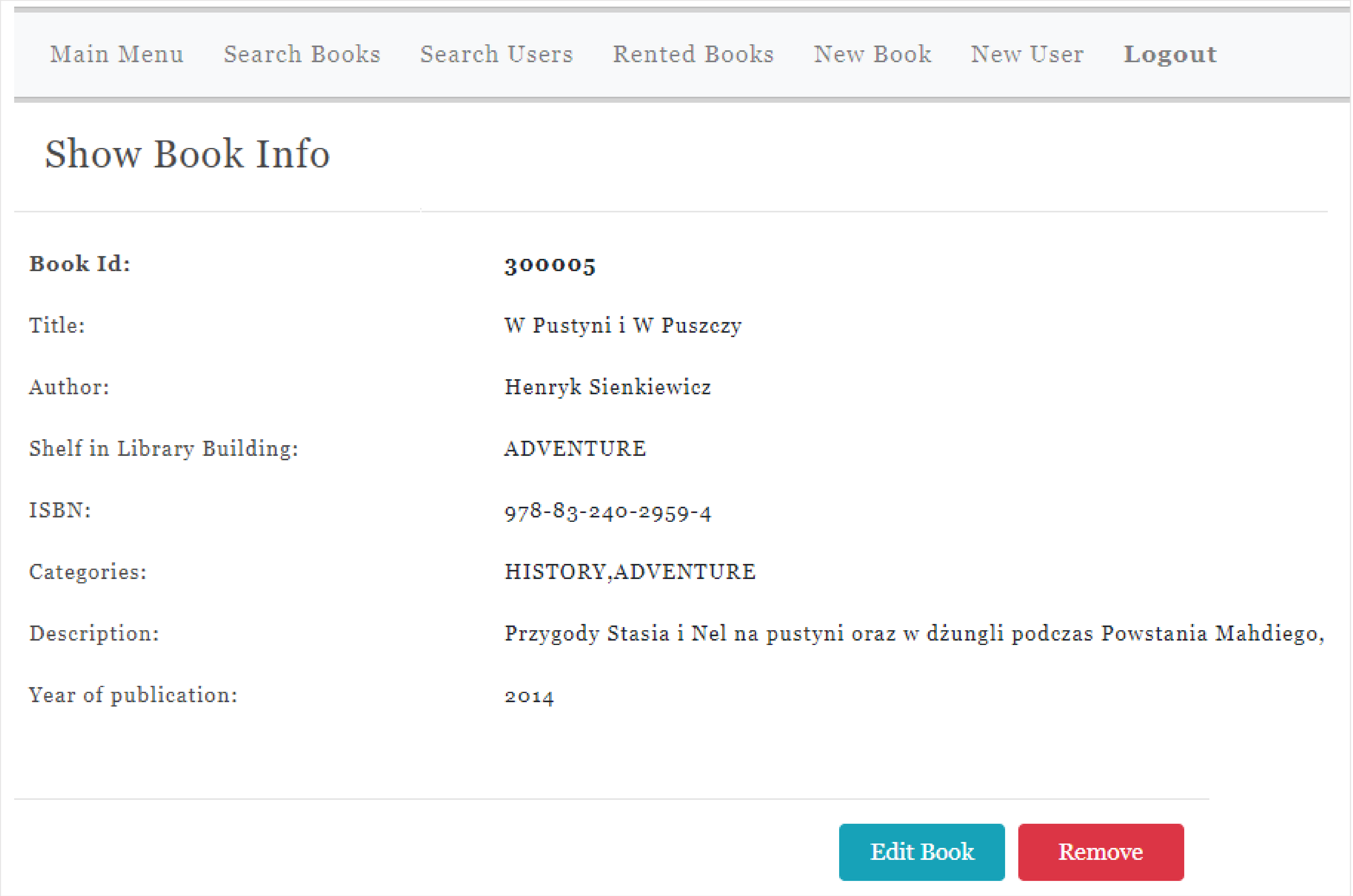
Description

Shelf (in library): Shelf

Year of publication: 0

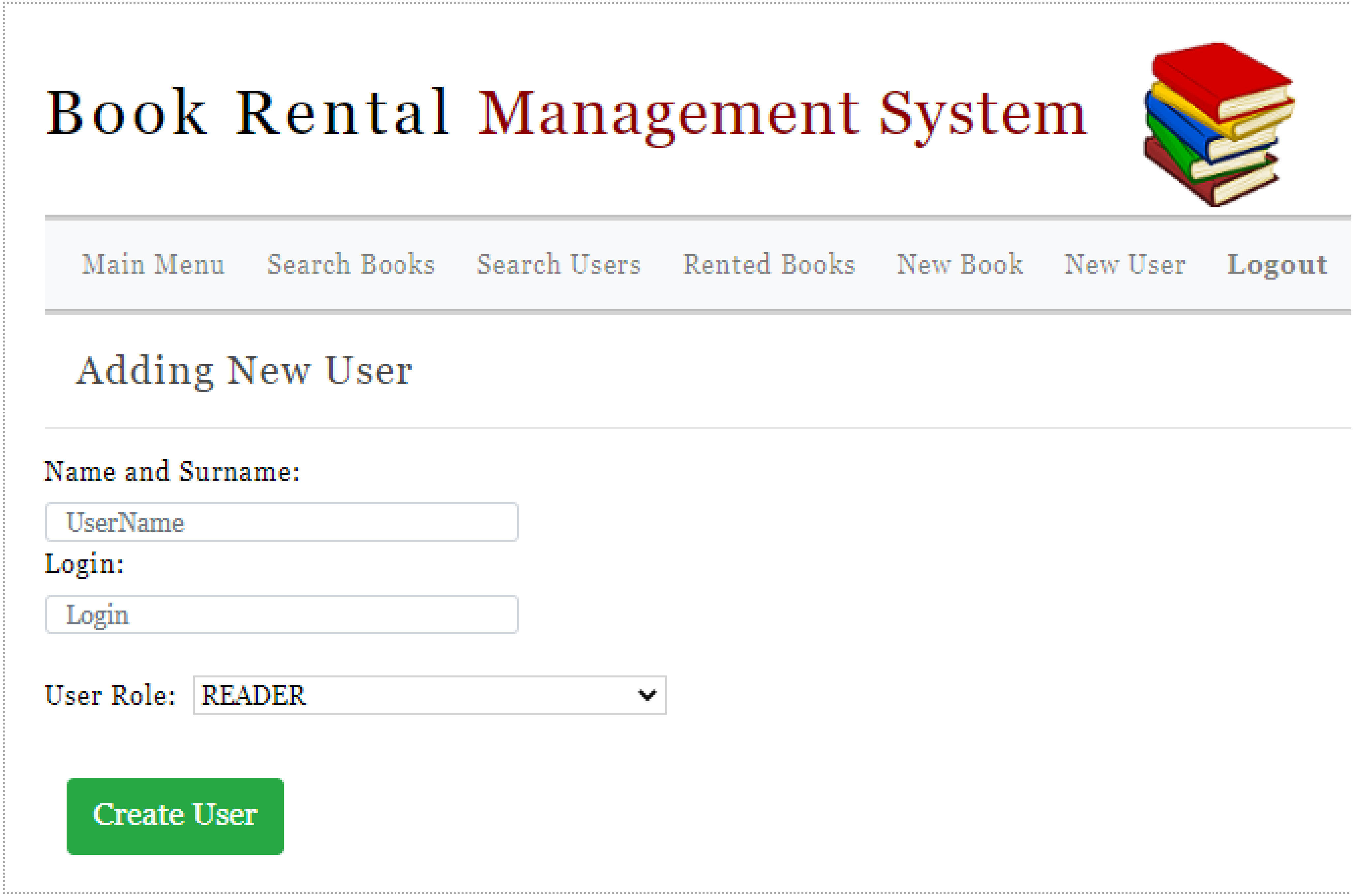
Categories:

□SCHOOL_BOOK
□DRAMA
□NOVEL
□THRILLER
□CRIME_STORY
□FANTASY
□ROMANCE
□FAIRYTALE
□BIOGRAPHY
□ADVENTURE
□POETRY
□MANAGEMENT_AND_ECONOMY
□SHORT_STORY
□HISTORY



Show Book Info

Book Id:	**300005**
Title:	W Pustyni i W Puszczy
Author:	Henryk Sienkiewicz
Shelf in Library Building:	ADVENTURE
ISBN:	978-83-240-2959-4
Categories:	HISTORY,ADVENTURE
Description:	Przygody Stasia i Nel na pustyni oraz w dżungli podczas Powstania Mahdiego,
Year of publication:	2014



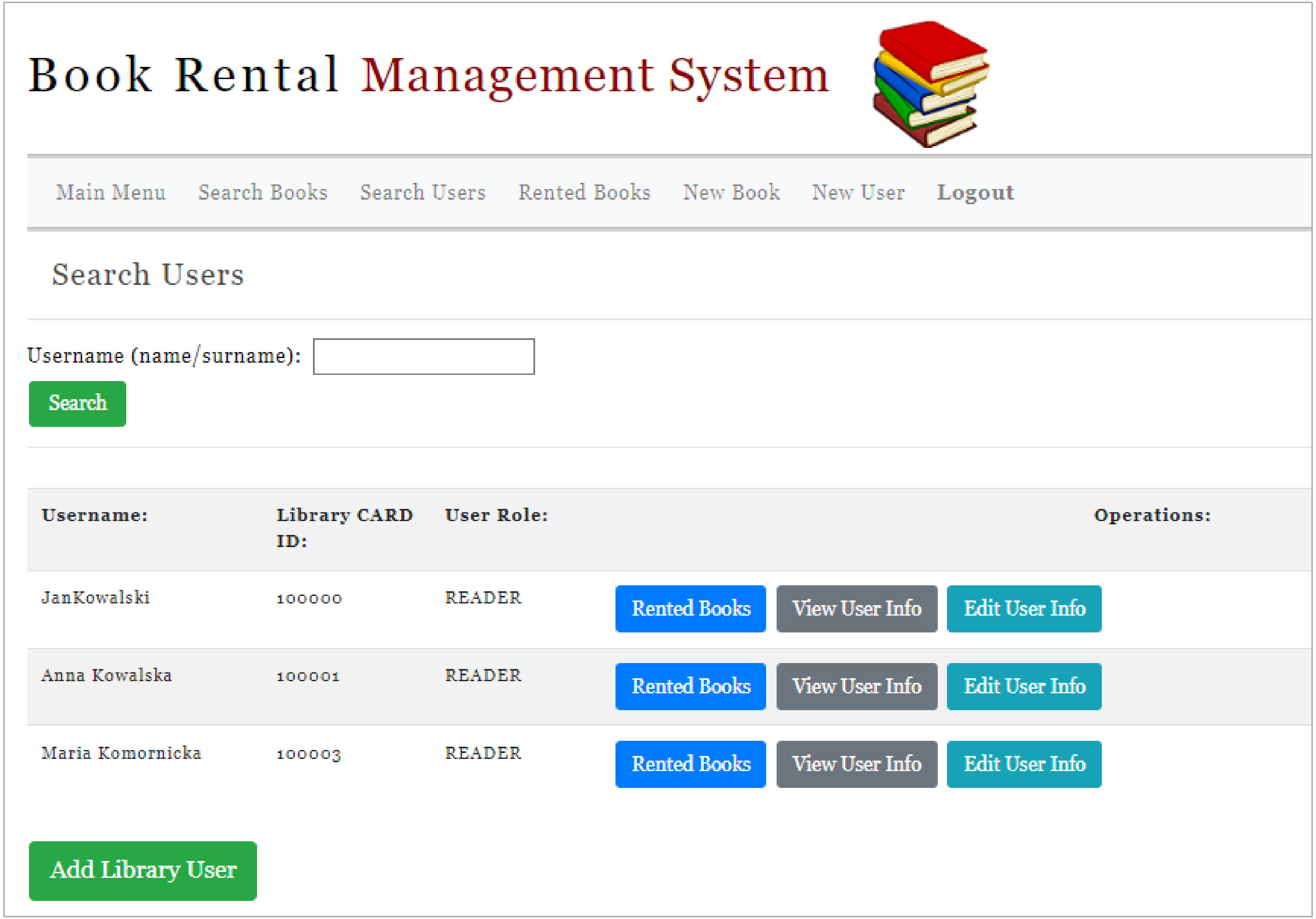
Book Rental Management System

Adding New User

Name and Surname: UserName

Login: Login

User Role: READER

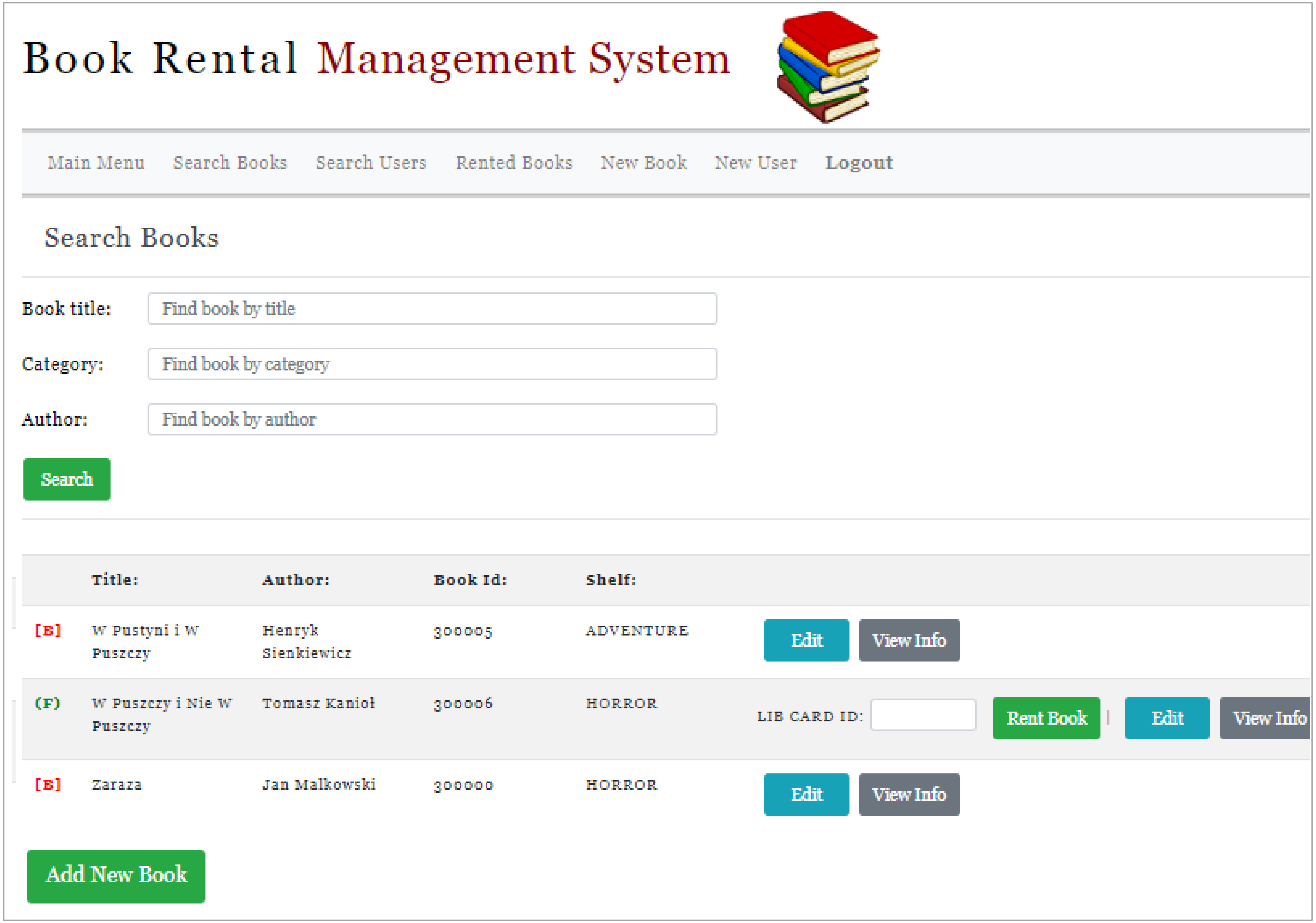


Book Rental Management System

Search Users

Username (name/surname):

Username:	Library CARD ID:	User Role:	Operations:
JanKowalski	100000	READER	Rented Books View User Info Edit User Info
Anna Kowalska	100001	READER	Rented Books View User Info Edit User Info
Maria Komornicka	100003	READER	Rented Books View User Info Edit User Info



Book Rental Management System

Main Menu | Search Books | Search Users | Rented Books | New Book | New User | **Logout**

Search Books

Book title: Find book by title

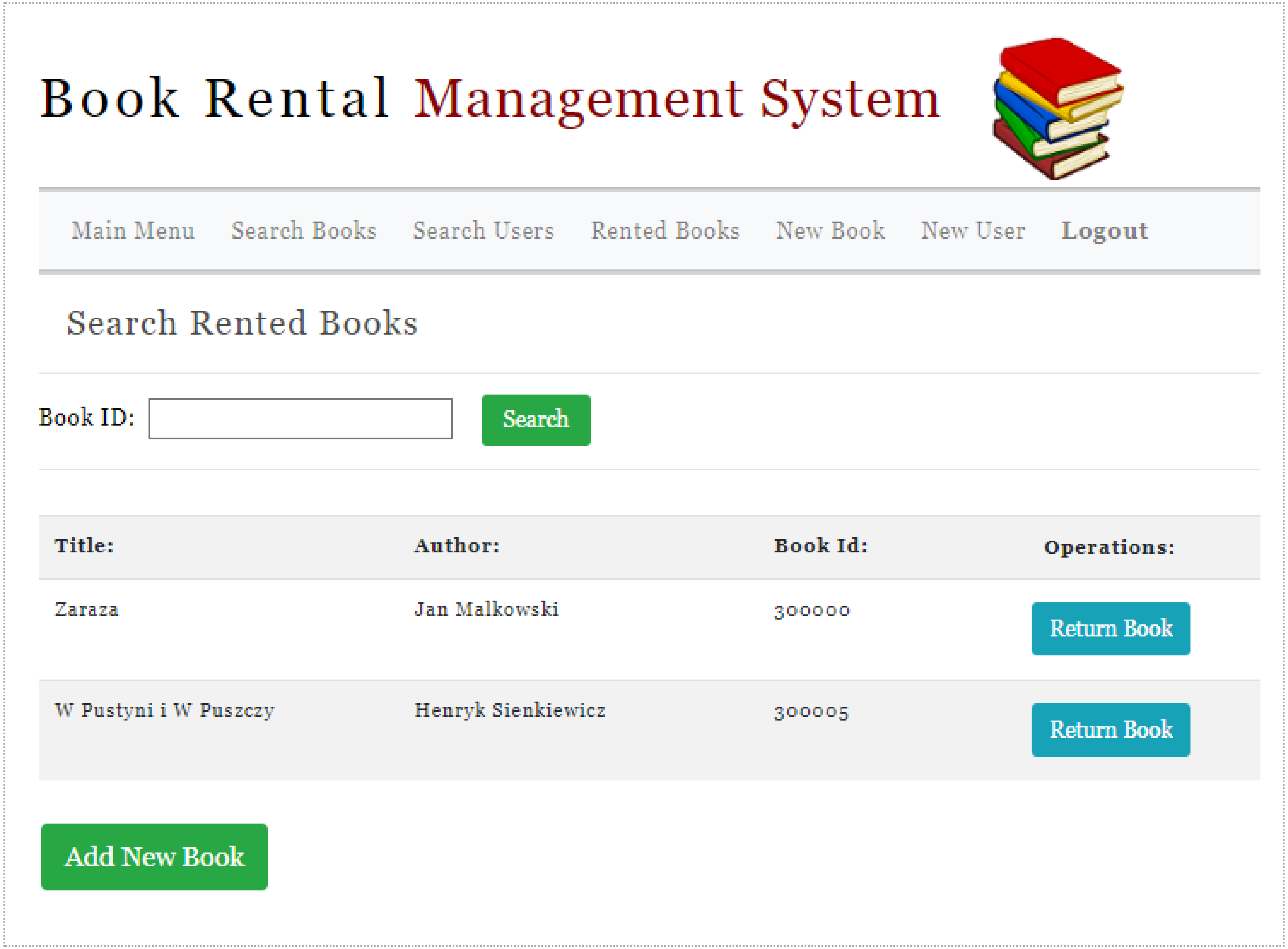
Category: Find book by category

Author: Find book by author

Search

	Title:	Author:	Book Id:	Shelf:	
[B]	W Pustyni i W Puszczy	Henryk Sienkiewicz	300005	ADVENTURE	Edit View Info
(F)	W Puszczy i Nie W Puszczy	Tomasz Kanioł	300006	HORROR	LIB CARD ID: Rent Book | Edit View Info
[B]	Zaraza	Jan Malkowski	300000	HORROR	Edit View Info

Add New Book



Search Rented Books

Book ID:

Title:	Author:	Book Id:	Operations:
Zaraza	Jan Malkowski	300000	Return Book
W Pustyni i W Puszczy	Henryk Sienkiewicz	300005	Return Book

<< IT'S SHOWTIME >>

Book Rental Application

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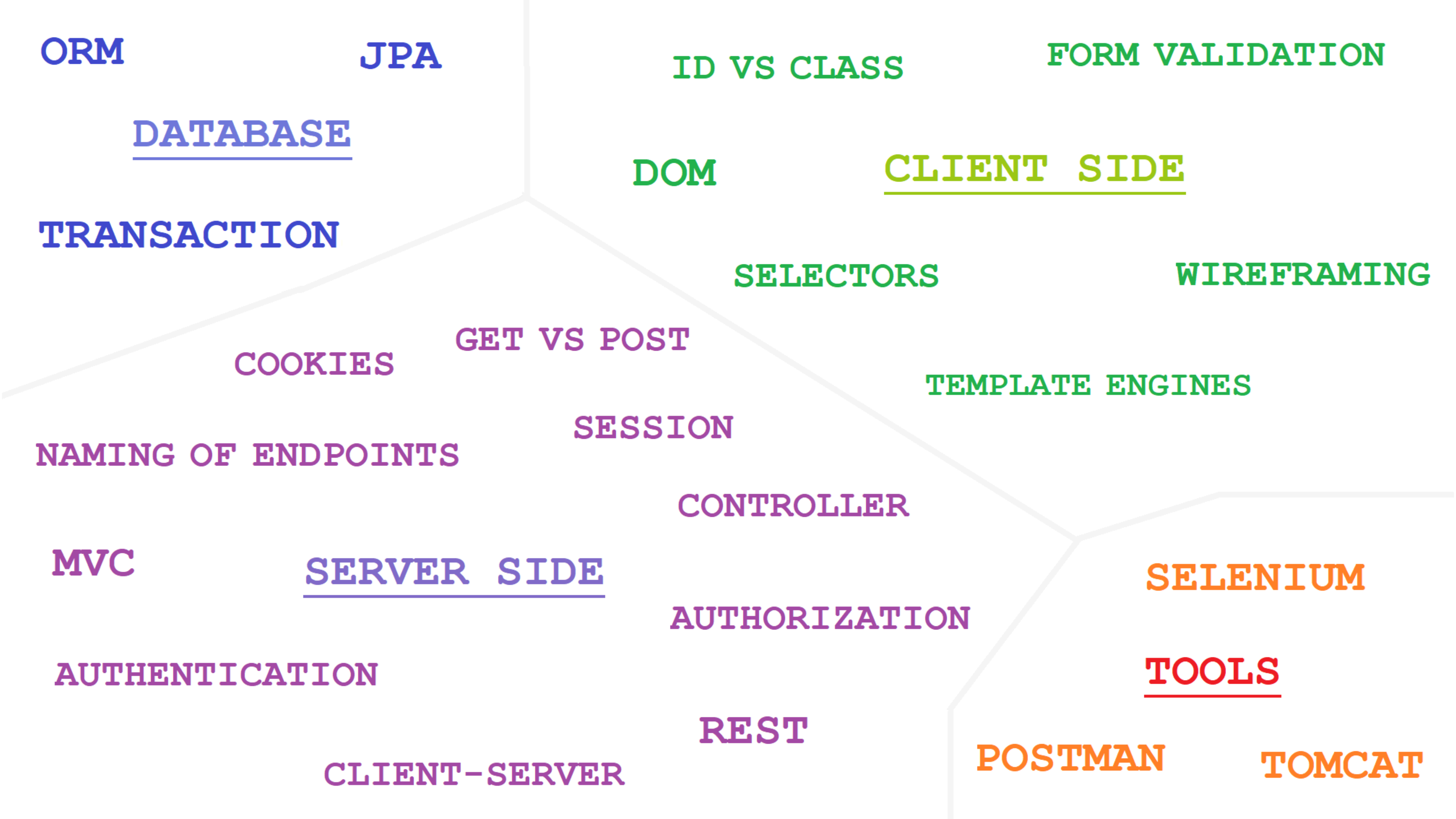
Implementation

- In the previous chapter we discussed the functional specification of our app.

- Now, we know what our system does, so we can proceed to designing technical aspects of it,

- We will discuss the following aspects:
  - backend technologies,
  - database schema,
  - structure of the project,
  - frontend technologies,

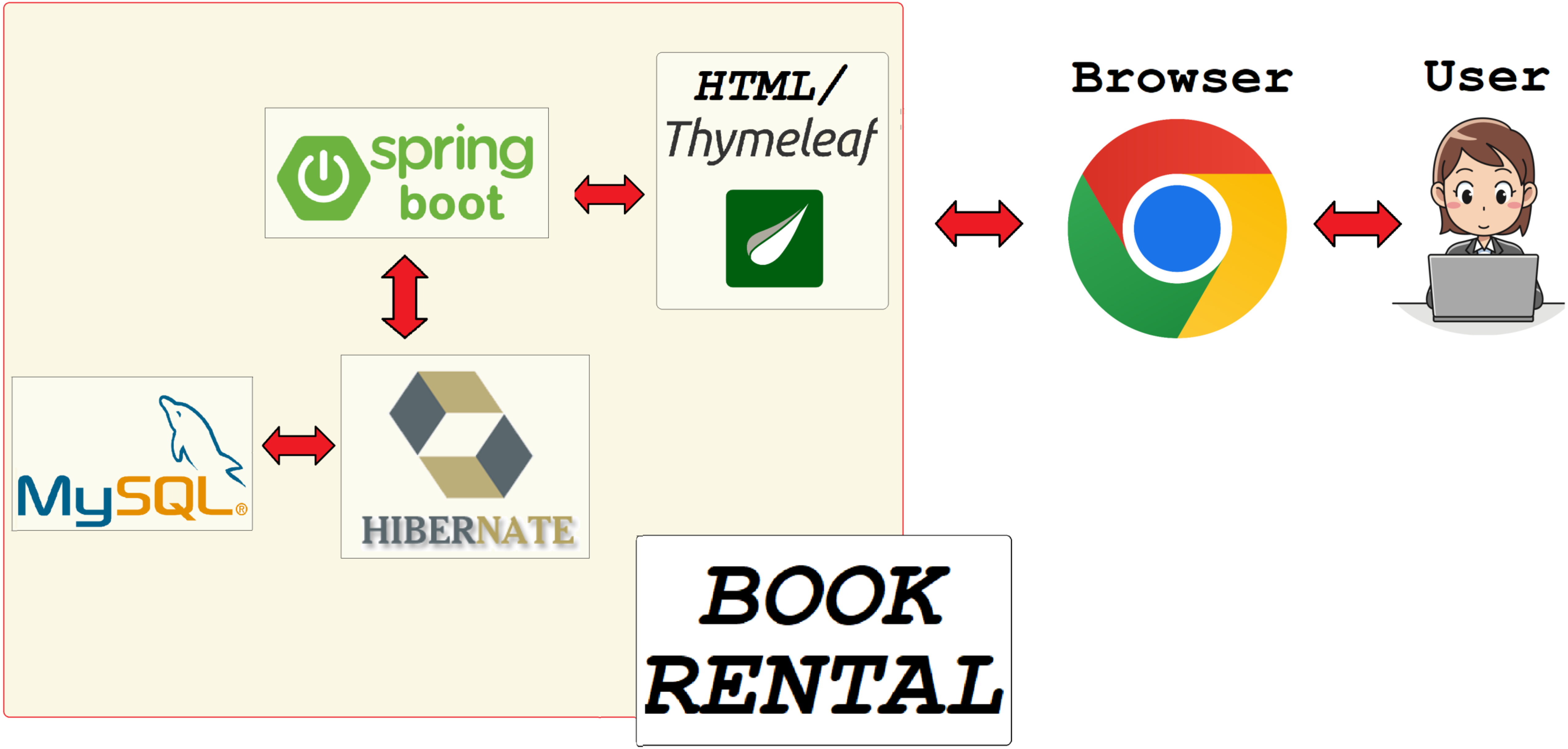


ORM
JPA
DATABASE
TRANSACTION

ID VS CLASS
FORM VALIDATION
DOM
CLIENT SIDE
SELECTORS
WIREFRAMING
TEMPLATE ENGINES

GET VS POST
COOKIES
SESSION
NAMING OF ENDPOINTS
CONTROLLER
MVC
SERVER SIDE
AUTHORIZATION
AUTHENTICATION
REST
CLIENT-SERVER

SELENIUM
TOOLS
POSTMAN
TOMCAT



HTML/ Thymeleaf

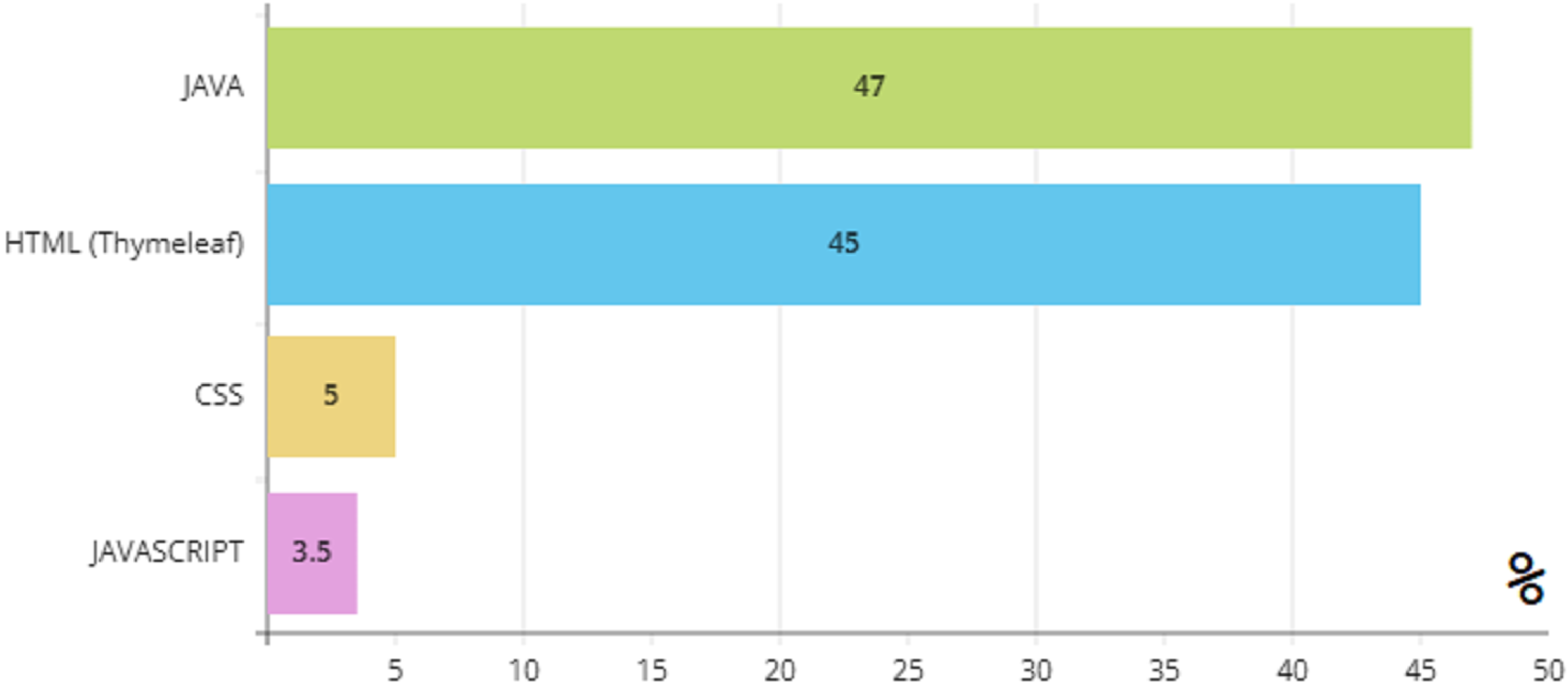
Browser

User

BOOK RENTAL

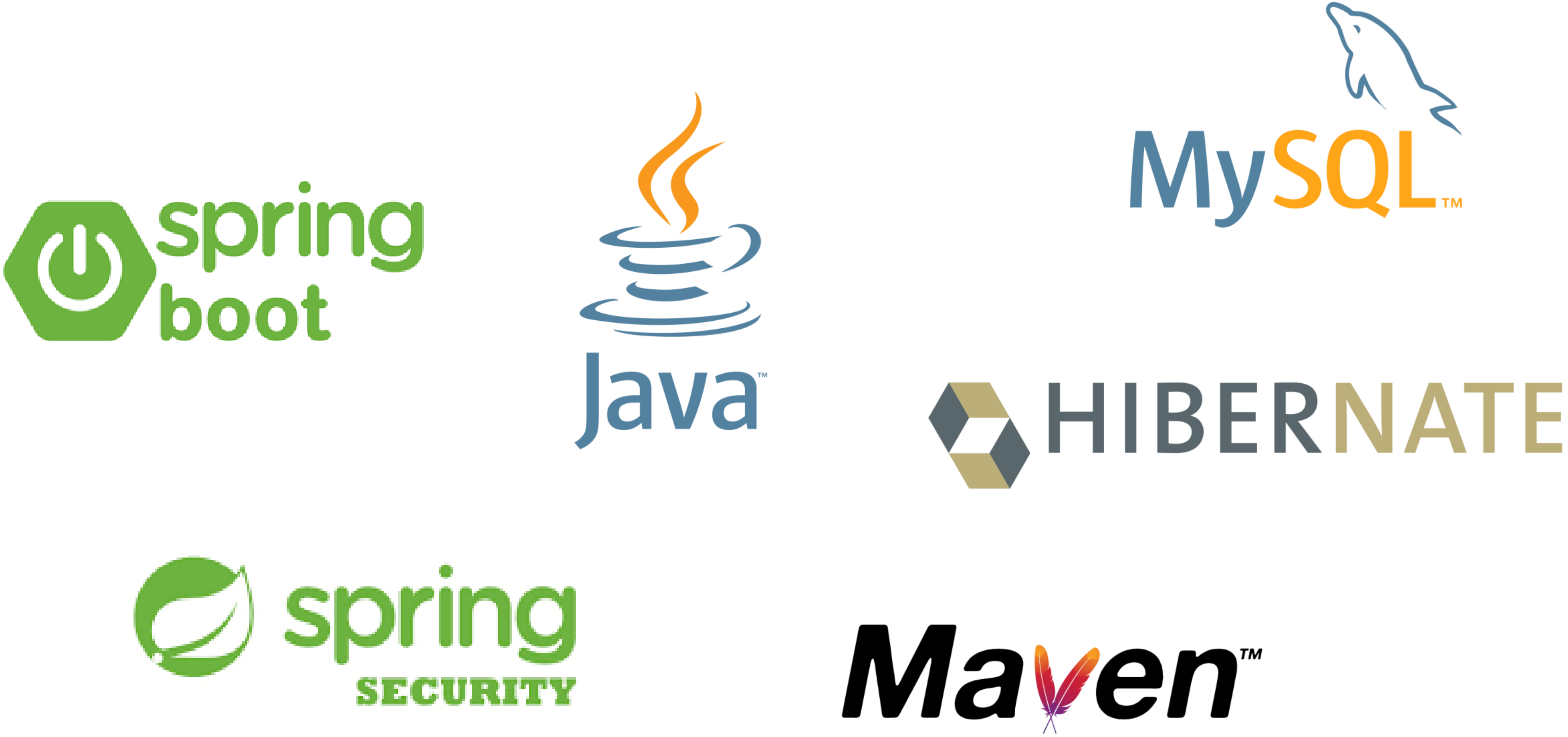
Technologies

excluding bootstrap and JQuery



2 Implementation - Backend

Technologies used for backend



General Idea of Project – Make Our Lives Easier!

- No need to manually add dependencies to pom - we can use Spring Initializr and choose desired components,

- We are not creating tables/relations - Hibernate is doing this for us automatically,

- We are not installing Tomcat Server to run web app - it is already included in Spring Boot,

- As for Authentication/Authorization, for example preparing login page and displaying certain things for certain roles – Spring Security is helping us heavily!

<< IT'S SHOWTIME >>

Initializr

Spring boot – what is it?

- Open-source java-based framework used **to create micro-Services**,
- **We can start our work with minimum configuration** -> Spring boot initializer ,
- No need for installing server – tomcat is already provided,
- **Easy to understand**, lots of free tutorials available,
- Using Spring Boot, we can **eliminate** most of the **boilerplate configuration.**

We can create our applications much easier/faster!

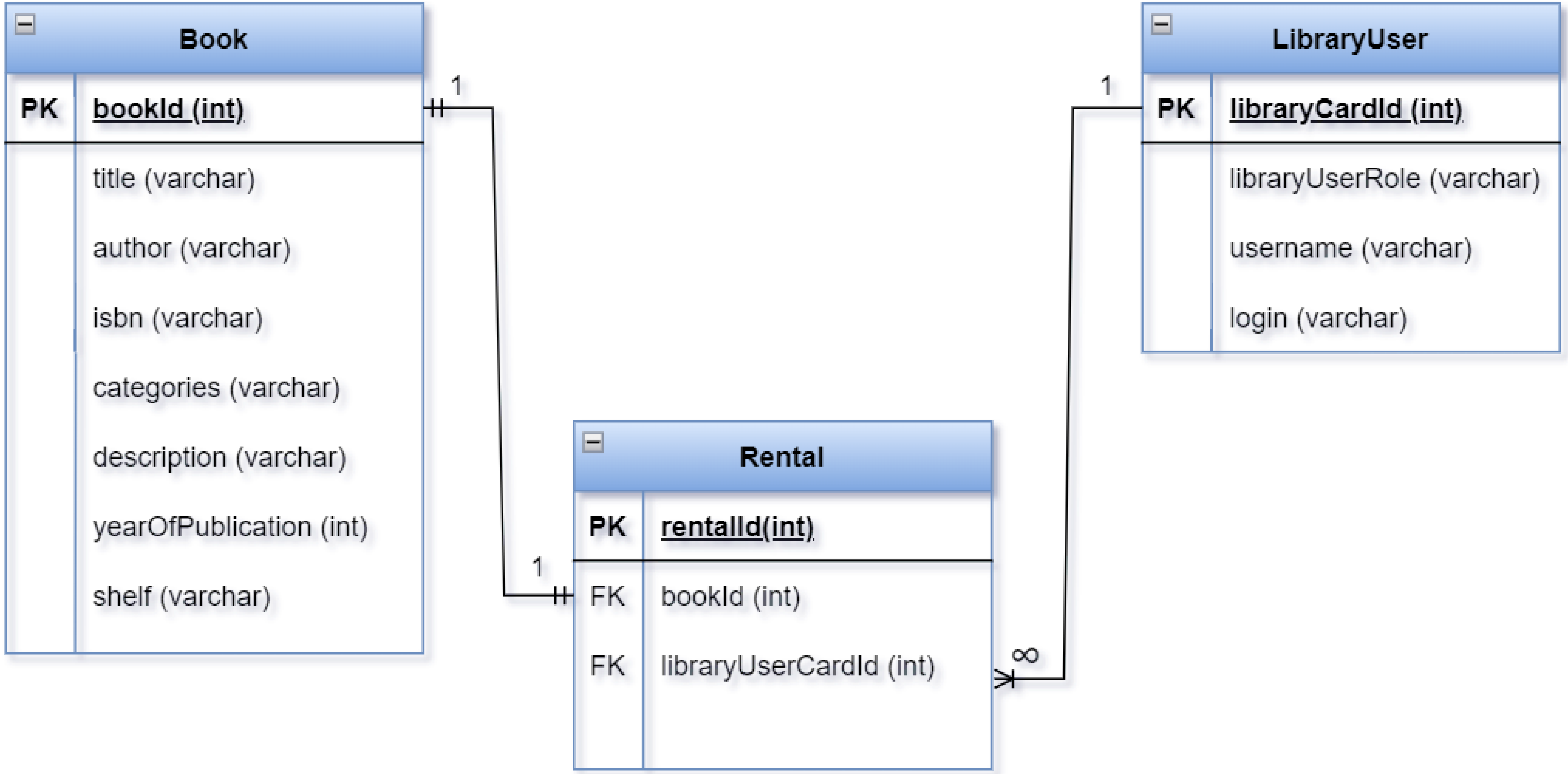
Spring boot – what is it?

- **Spring boot provides:**
  - **flexible way to configure Java Beans, xml configurations and database transactions,**
  - Powerful batch processing & **managing REST endpoints,**
  - **Auto configuration** – no manual configurations needed,
  - **Annotation-based application,**
  - **Easy dependency management,**
  - **Included Embedded Servlet Container,**
  - **Security library** – handling logging (includes default forms), integration with Thymeleaf.

Database schema

Library data base schema

Simplified database schema of Book Rental system used to implement project for IT FOR SHE workshops 2022



Book	
PK	**bookId (int)**
	title (varchar)
	author (varchar)
	isbn (varchar)
	categories (varchar)
	description (varchar)
	yearOfPublication (int)
	shelf (varchar)

LibraryUser	
PK	**libraryCardId (int)**
	libraryUserRole (varchar)
	username (varchar)
	login (varchar)

Rental	
PK	**rentalId(int)**
FK	bookId (int)
FK	libraryUserCardId (int)

Database –Hibernate & MySQL

- **Hibernate is:**
    - One of the most popular **implementation of JPA** (Java Persistent API),
    - **Object relational mapping (ORM) tool** providing a framework to map object-oriented domain models to relational databases for web applications (**maps java classes into database tables and java data types to SQL data types and provides querying and retrieval**).

- **Benefits of using hibernate:**
    - Open-source,
    - Database type independent – connectors available for any database like Oracle, MySQL, PostgreSQL etc
    - Automatic table creation – no manual work in database needed,
    - Handling database creation if it does not exist,

Database – Hibernate & MySQL

Benefits of using hibernate:

- Transparent persistence – ensures the automatic connection between application's objects with the database tables,
- HQL (Hibernate Query Language) – object-oriented version of SQL generating database independent queries,
- Easier data fetching from multiple tables.

Database —Hibernate & MySQL

Prerequisites:

- MySQL (or any other **database** you want to use) **needs to be installed** on your computer,
- Under resources **there must be application.properties file defined**,
- In properties file we define e.g., URL of database source, type of connector, credentials to access database,
- **Proper connector and hibernate** related **dependencies** must be present **in pom.xml**.

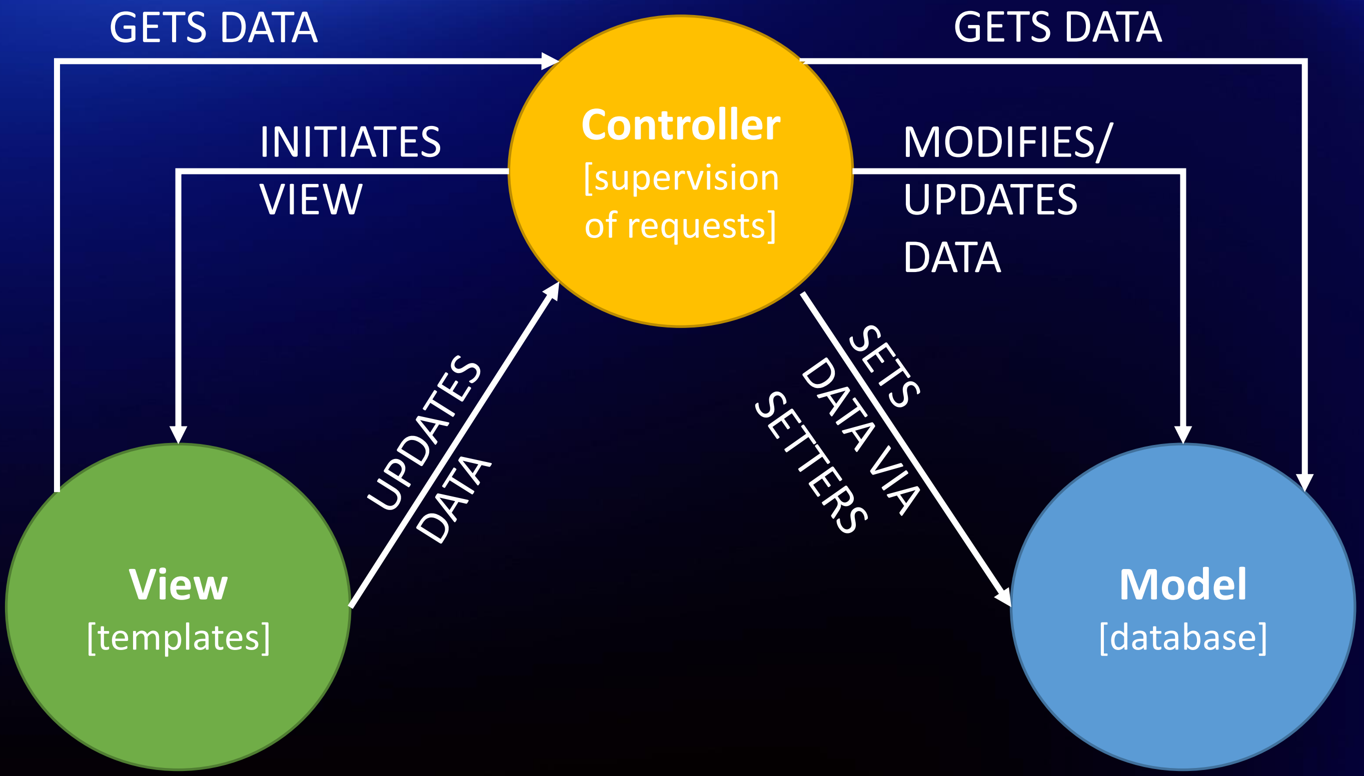
Database –Hibernate & MySQL

Annotation for model classes:

- **All java classes** that shall be converted to tables **need to be annotated with @Table**,
- **Java fields** of mapped classes **need to have annotation @Column**,
- For Primary Key (PK) we can use autogenerated ID within annotations **@Id** and **@GeneratedValue**,
- Relations between tables (FK) are annotated by **@ManyToOne**, **@OneToOne**, **@OneToMany**, **@ManyToMany** tags.

MVC

Model View Controller (MVC) – design pattern that specifies that an application is split into model, presentation information and control information. It requires that each mentioned part is separated into different object.



Spring Boot vs Spring MVC

spring MVC

- MVC pattern-based framework for building web applications,
- Requires lots of configurations – e.g., for DispatcherServlet and View Resolver,
- Every dependency needs to be specified separately for the features to run.

spring boot

- Most widely used framework in the REST API development field. Developed on top of conventional Spring framework. Used for stand-alone web spring applications,
- Auto-configuration
- Concept of predefined app skeletons – once it is added to the class path, all needed dependencies are brought for development.

REST methods - overview

REST (Representational State Transfer) - an architectural style defining constraints to be used for web services.

REST != HTTP

REST principles:

- Uniform interface,
- Client – server separation,
- Stateless,
- Cacheability,
- Layered system,
- Code on demand.

REST methods - overview

Example **REST methods**:

- **GET** – fetch data from database – e.g., show details for certain book or search book by title,
- **POST** – add new data to database – e.g., new book in library,
- **PUT** – update information in database – e.g., edit data for certain library user,
- **DELETE** – remove data from database – e.g., delete library user.

REST URLs/Endpoints naming – Nouns,

Our application is NOT fully RESTFUL, but we follow the guidelines to some extent:

URL / ENDPOINT	HTTP METHOD	ACTION
/users	GET	List with **many** users,
/users	POST	Adding **new** user,
/users/{id}	GET	Details page for **one** user **having certain ID**,
/users/{id}	PUT	Updating one **user** having certain ID,
/books	GET	List with **many** books,
/books	POST	Adding **new** book,
/books/{id}	GET	Details page for **one** book **having certain ID**,
/books/{id}	PUT	Updating one **book** having certain ID,
/rented-books	GET	List with **many** books **that are rented,**
/books-rented-by-user/{userId}	GET	List with **many** books **rented by certain user** (user has certain userId)

Spring security in backend

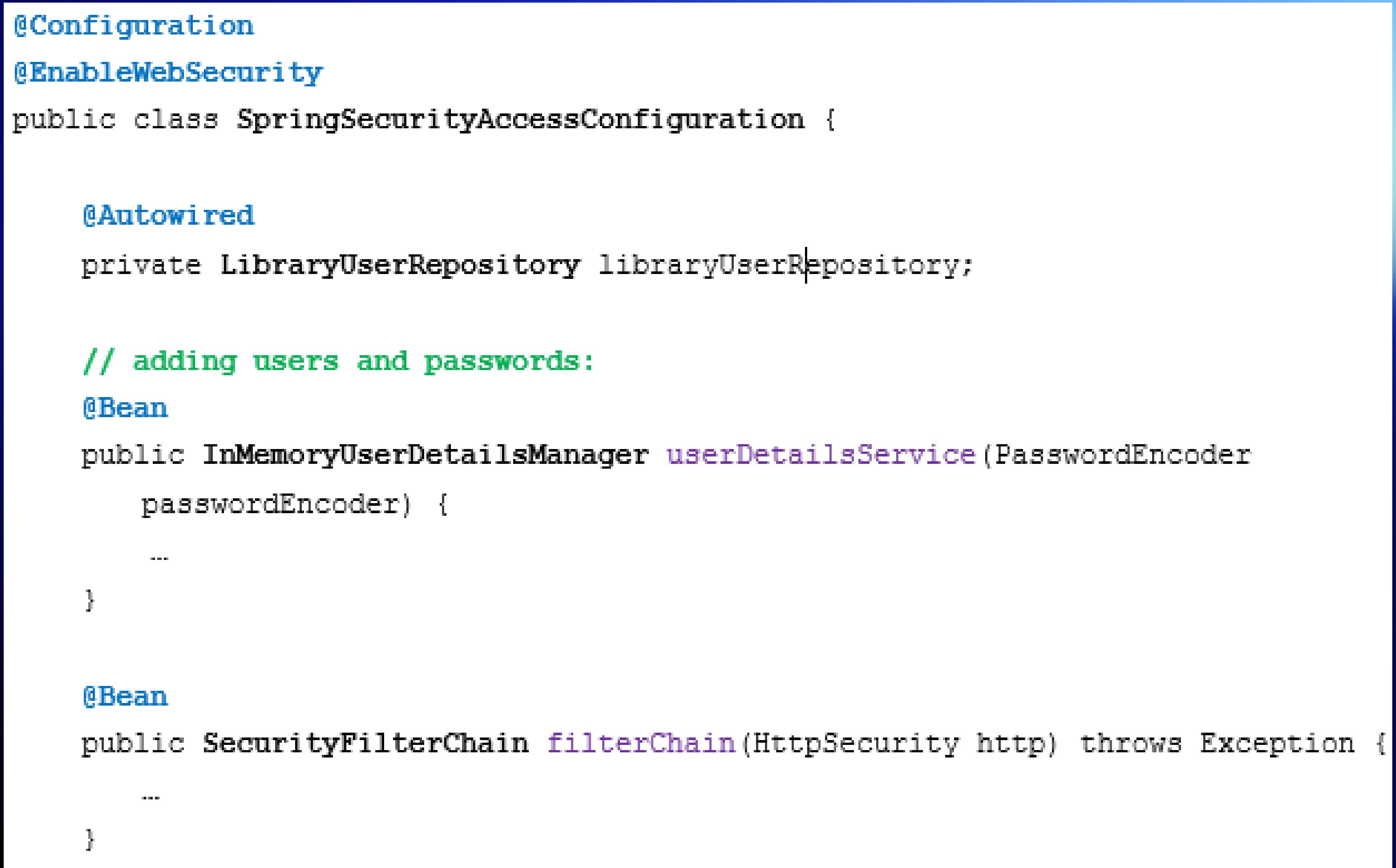
Spring Security is a framework that supports authentication / authorization / access-control.

Authorization is any mechanism by which a system grants or revokes the right to perform some action or access some data.

Authentication – who are you?

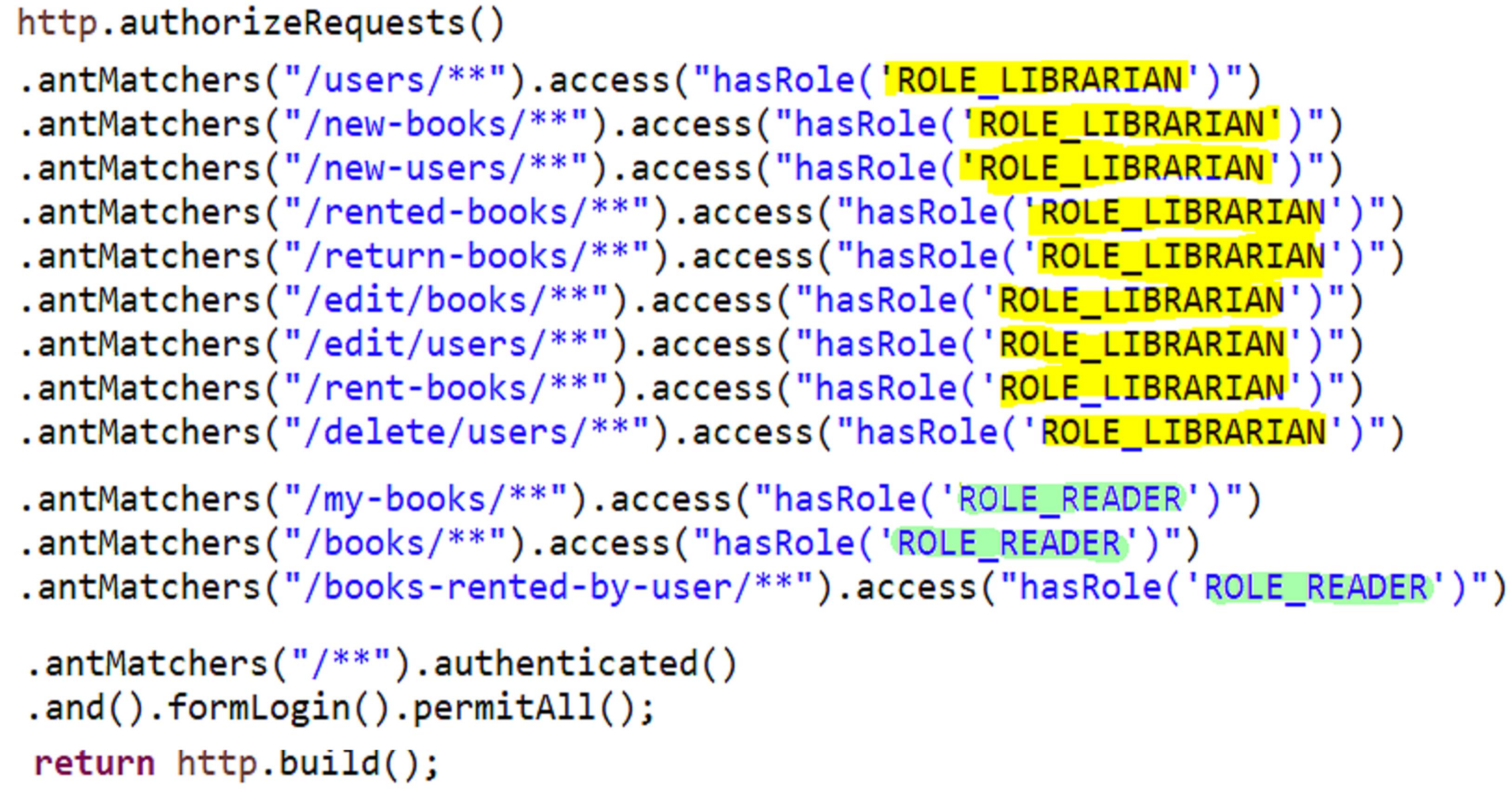
Authorization – what are you allowed to do?

Spring security in backend



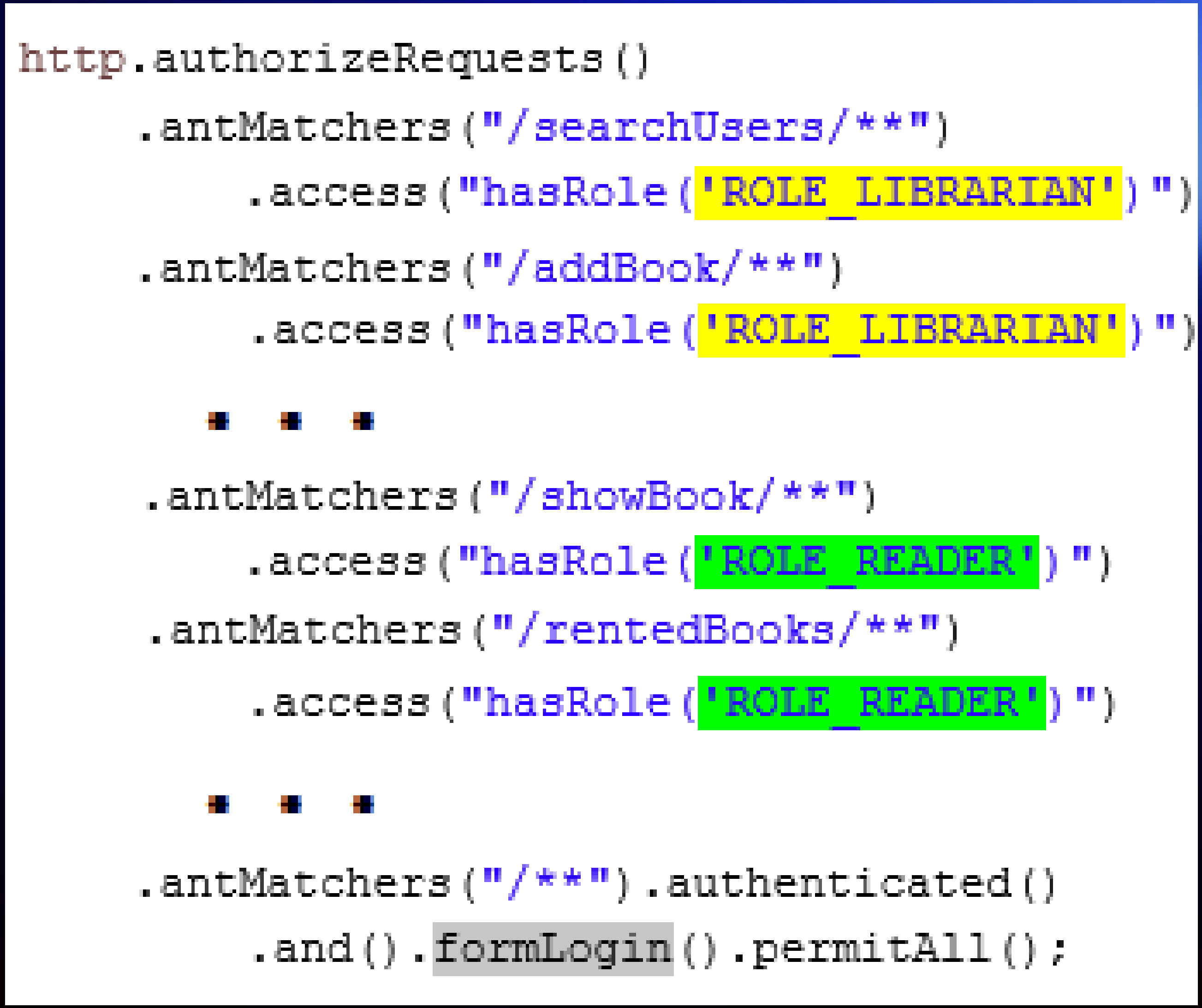
```
@Configuration
@EnableWebSecurity
public class SpringSecurityAccessConfiguration {

    @Autowired
    private LibraryUserRepository libraryUserRepository;

    // adding users and passwords:
    @Bean
    public InMemoryUserDetailsManager userDetailsService(PasswordEncoder
        passwordEncoder) {
         ...
    }

    @Bean
    public SecurityFilterChain filterChain(HttpSecurity http) throws Exception {
        ...
    }
```

Spring Security



```
http.authorizeRequests()

.antMatchers("/users/**").access("hasRole('ROLE_LIBRARIAN')")
.antMatchers("/new-books/**").access("hasRole('ROLE_LIBRARIAN')")
.antMatchers("/new-users/**").access("hasRole('ROLE_LIBRARIAN')")
.antMatchers("/rented-books/**").access("hasRole('ROLE_LIBRARIAN')")
.antMatchers("/return-books/**").access("hasRole('ROLE_LIBRARIAN')")
.antMatchers("/edit/books/**").access("hasRole('ROLE_LIBRARIAN')")
.antMatchers("/edit/users/**").access("hasRole('ROLE_LIBRARIAN')")
.antMatchers("/rent-books/**").access("hasRole('ROLE_LIBRARIAN')")
.antMatchers("/delete/users/**").access("hasRole('ROLE_LIBRARIAN')")

.antMatchers("/my-books/**").access("hasRole('ROLE_READER')")
.antMatchers("/books/**").access("hasRole('ROLE_READER')")
.antMatchers("/books-rented-by-user/**").access("hasRole('ROLE_READER')")

.antMatchers("/**").authenticated()
.and().formLogin().permitAll();

return http.build();
```

Spring security in backend



```
http.authorizeRequests()
     .antMatchers("/searchUsers/**")
          .access("hasRole('ROLE_LIBRARIAN')")
     .antMatchers("/addBook/**")
          .access("hasRole('ROLE_LIBRARIAN')")

        . . .

     .antMatchers("/showBook/**")
          .access("hasRole('ROLE_READER')")
     .antMatchers("/rentedBooks/**")
          .access("hasRole('ROLE_READER')")

        . . .

     .antMatchers("/**").authenticated()
          .and().formLogin().permitAll();
```

Only users with Librarian role can access this .

Users with Reader role can access this (but in our application each Librarian has both roles – this is up to your config).

All users should be able to reach login page.

<< IT ' S SHOWTIME >>

Project’s Structure

<< IT'S SHOWTIME >>

Database & Model
Controllers
Thymeleaf (VIEW)

3 View - Frontend

Technologies used for frontend

Thymeleaf – what is it?

Thymeleaf **open-source server-side Java template engine for** both **web and standalone environment**. It processes and creates HTML, XML, JavaScript, CSS and text. It provides full integration with Spring Framework.

Thymeleaf templates look similar to normal HTML format (much more similar than for example older JSP)

It is compatible with HTML and **supports variable expressions** (${...}) like Spring Expression Language and executes on model attributes, asterisk expressions (*{...}) execute on the form backing bean, hash expressions (#{...}) are for internationalization, and link expressions (@{...}) rewrite URLs.

Thymeleaf – form methods

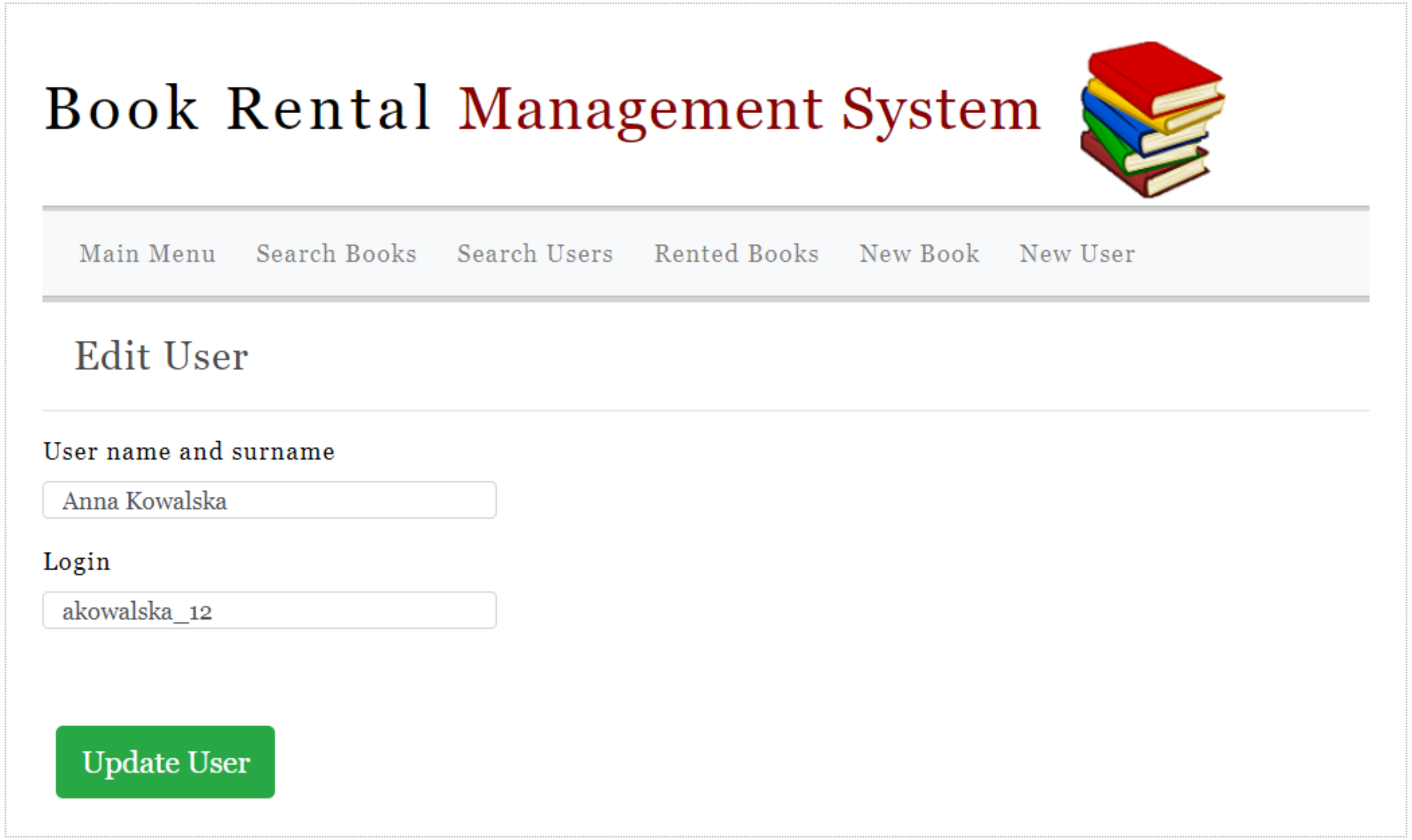
Thymeleaf - as it is an engine that supports HTML, we must remember that **it supports only GET and POST methods**. Due to that restriction if we want to use PUT/DELETE methods within Thymeleaf we need to add extra property to application.properties file:

spring.mvc.hiddenmethod.filter.enabled=true

HiddenHttpMethodFilter allows Thymeleaf to use PUT/DELETE.
If you have in form th:method=”put”, then Thymeleaf will use post as the actual method on the form and insert an extra hidden input _method with the preferred HTTP method

Source article

Thymeleaf – PUT form example



Book Rental Management System

Main Menu   Search Books   Search Users   Rented Books   New Book   New User

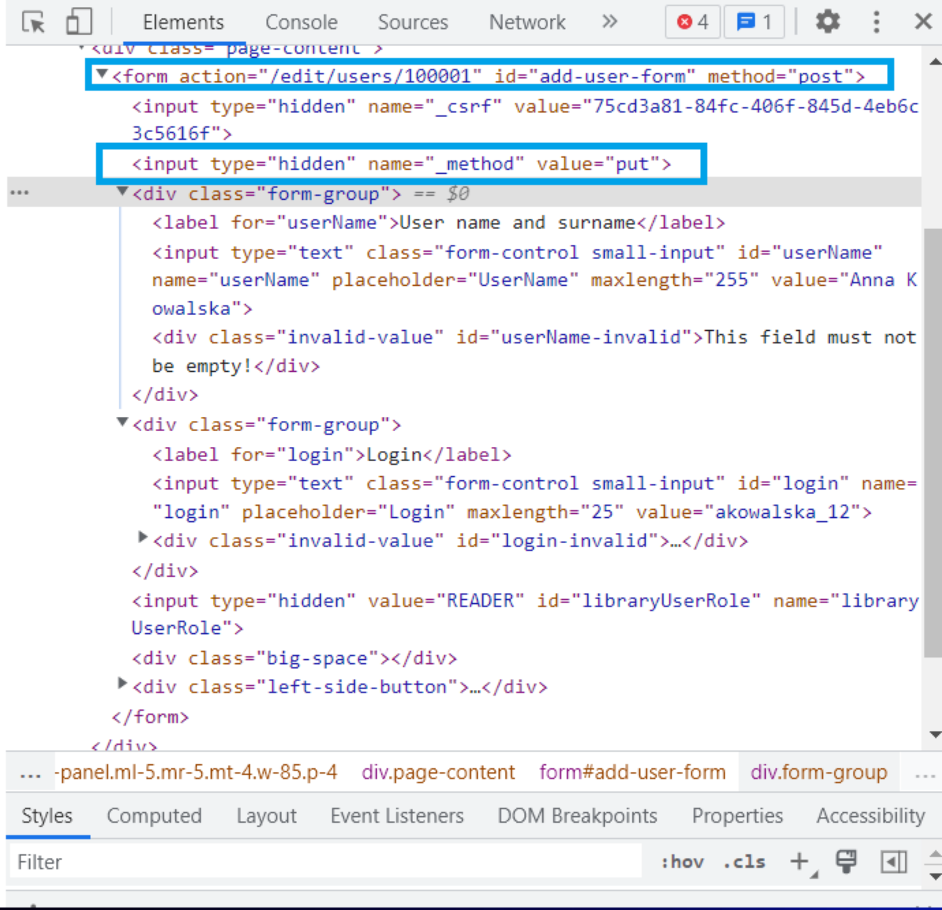
Edit User

User name and surname

Anna Kowalska

Login

akowalska_12

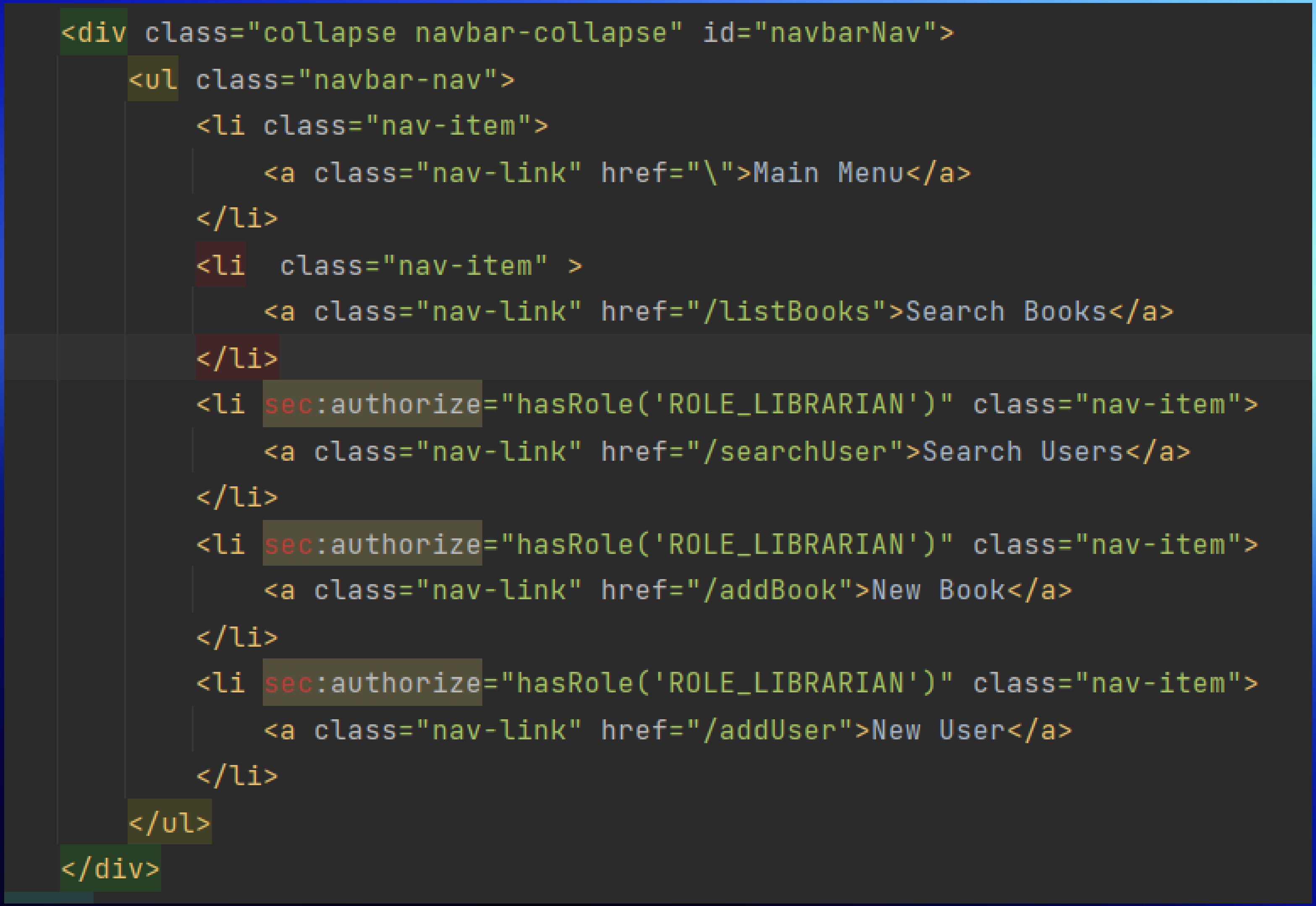


```
<div class="page-content">
▼<form action="/edit/users/100001" id="add-user-form" method="post">
   <input type="hidden" name="_csrf" value="75cd3a81-84fc-406f-845d-4eb6c
   3c5616f">
   <input type="hidden" name="_method" value="put">
 ▼<div class="form-group"> == $0
     <label for="userName">User name and surname</label>
     <input type="text" class="form-control small-input" id="userName"
     name="userName" placeholder="UserName" maxlength="255" value="Anna K
     owalska">
     <div class="invalid-value" id="userName-invalid">This field must not
     be empty!</div>
   </div>
 ▼<div class="form-group">
     <label for="login">Login</label>
     <input type="text" class="form-control small-input" id="login" name=
     "login" placeholder="Login" maxlength="25" value="akowalska_12">
    ▶<div class="invalid-value" id="login-invalid">…</div>
   </div>
   <input type="hidden" value="READER" id="libraryUserRole" name="library
   UserRole">
   <div class="big-space"></div>
 ▶<div class="left-side-button">…</div>
 </form>
</div>
```

… -panel.ml-5.mr-5.mt-4.w-85.p-4   div.page-content   form#add-user-form   div.form-group
Styles
Computed
Layout
Event Listeners
DOM Breakpoints
Properties
Accessibility
Filter
:hov
.cls
+

Thymeleaf integration with Spring Security

Integration with Spring Security allows to check if user is authenticated and handle displaying given elements in the form based on user's roles.



```
<div class="collapse navbar-collapse" id="navbarNav">
    <ul class="navbar-nav">
        <li class="nav-item">
            <a class="nav-link" href="\">Main Menu</a>
        </li>
        <li  class="nav-item" >
            <a class="nav-link" href="/listBooks">Search Books</a>
        </li>
        <li sec:authorize="hasRole('ROLE_LIBRARIAN')" class="nav-item">
            <a class="nav-link" href="/searchUser">Search Users</a>
        </li>
        <li sec:authorize="hasRole('ROLE_LIBRARIAN')" class="nav-item">
            <a class="nav-link" href="/addBook">New Book</a>
        </li>
        <li sec:authorize="hasRole('ROLE_LIBRARIAN')" class="nav-item">
            <a class="nav-link" href="/addUser">New User</a>
        </li>
    </ul>
</div>
```

Bootstrap

Bootstrap is open-source front-end development framework for the creation of websites and web apps.

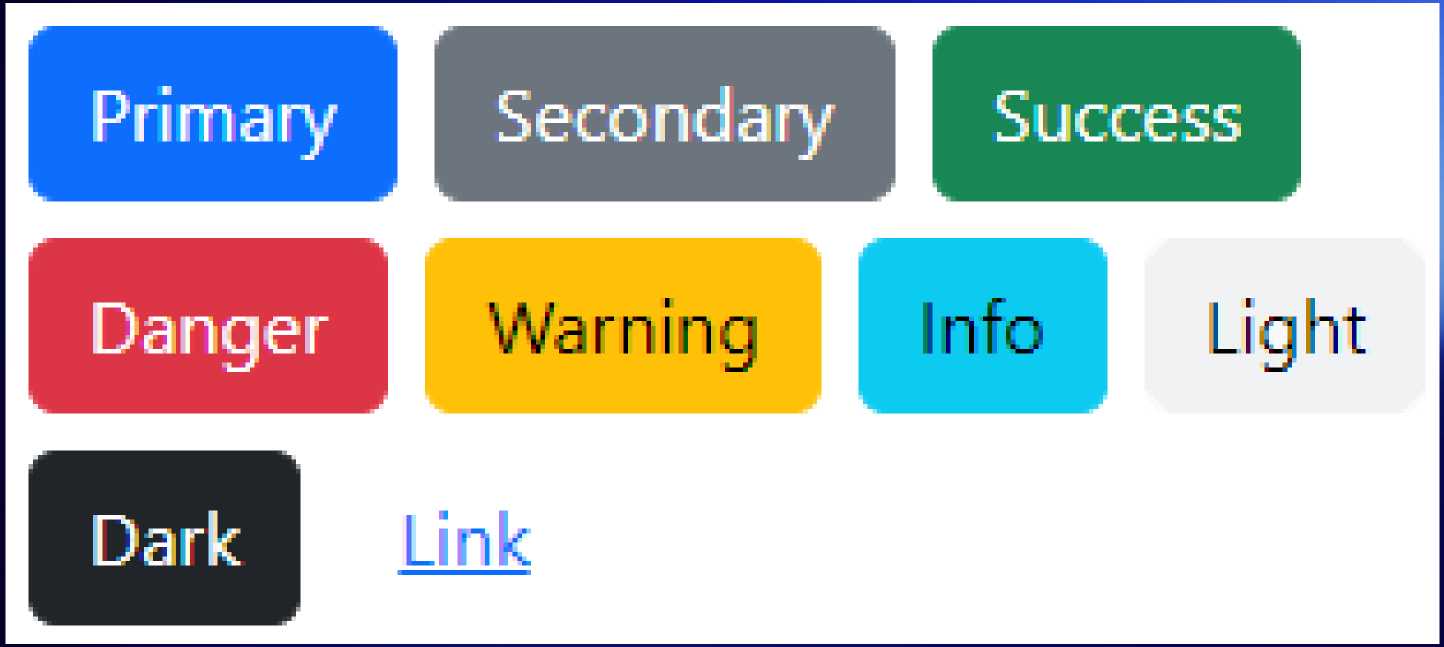
Bootstrap simplifies creating responsive, mobile-first front-end programs.

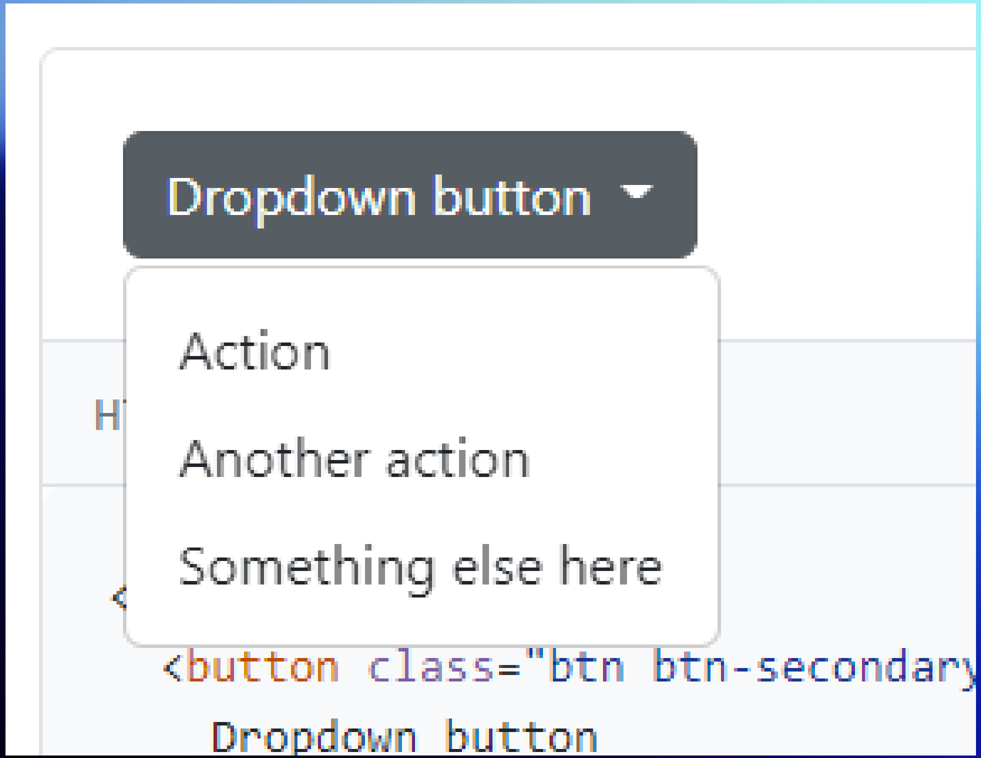
Bootstrap help us with appearance of our applications.

Bootstrap uses HTML, CSS, and JavaScript.

Bootstrap has ready solutions for many elements: buttons, alerts, modals, tabs, navigation bars, toolkits, dropdowns and many more…

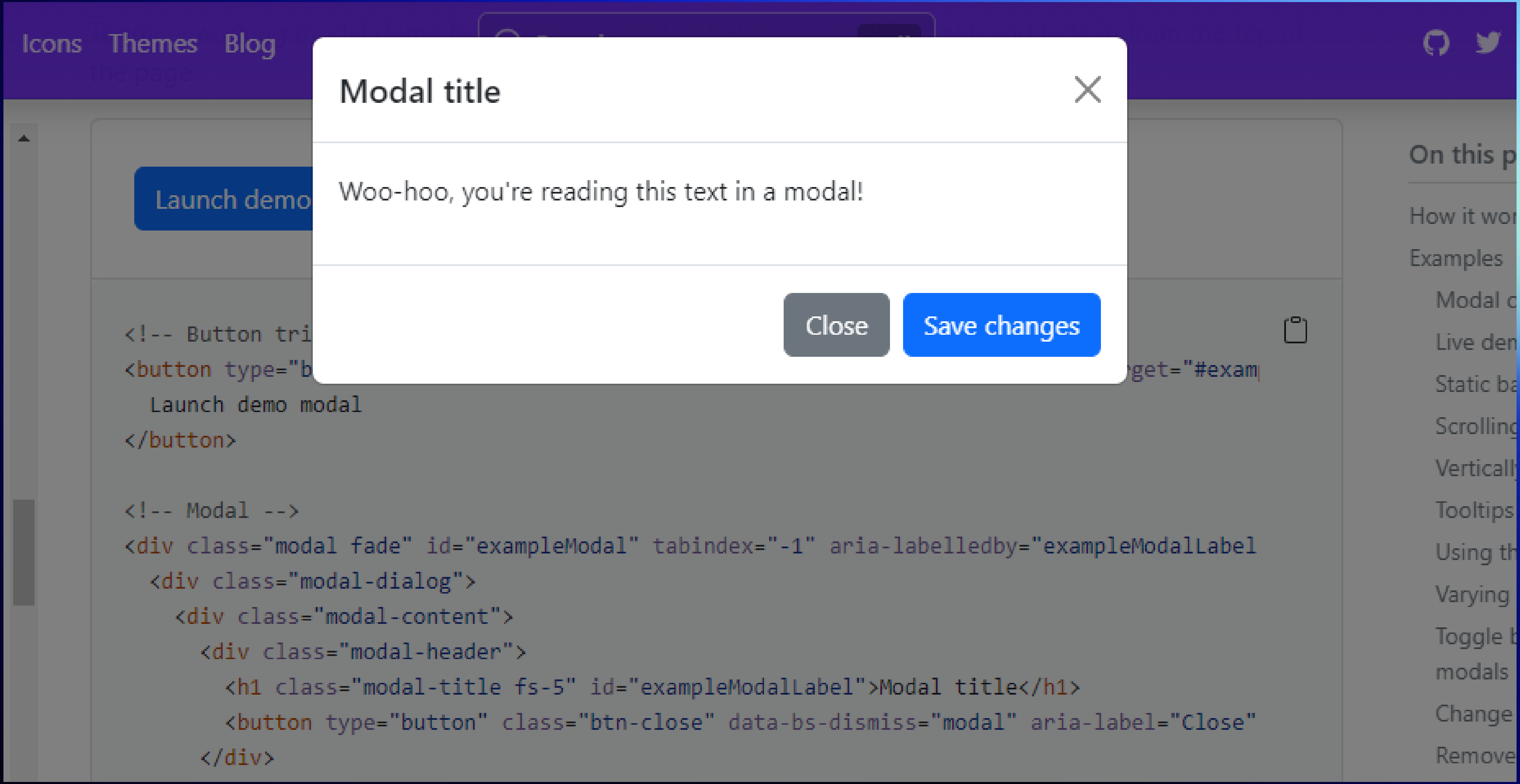
Bootstrap





```
<
  <button class="btn btn-secondary
    Dropdown button
```

Bootstrap



Woo-hoo, you're reading this text in a modal!

```
<!-- Button tri
<button type="b                                                 get="#exam
  Launch demo modal
</button>

<!-- Modal -->
<div class="modal fade" id="exampleModal" tabindex="-1" aria-labelledby="exampleModalLabel
  <div class="modal-dialog">
    <div class="modal-content">
      <div class="modal-header">
        <h1 class="modal-title fs-5" id="exampleModalLabel">Modal title</h1>
        <button type="button" class="btn-close" data-bs-dismiss="modal" aria-label="Close"
      </div>
```

JQuery

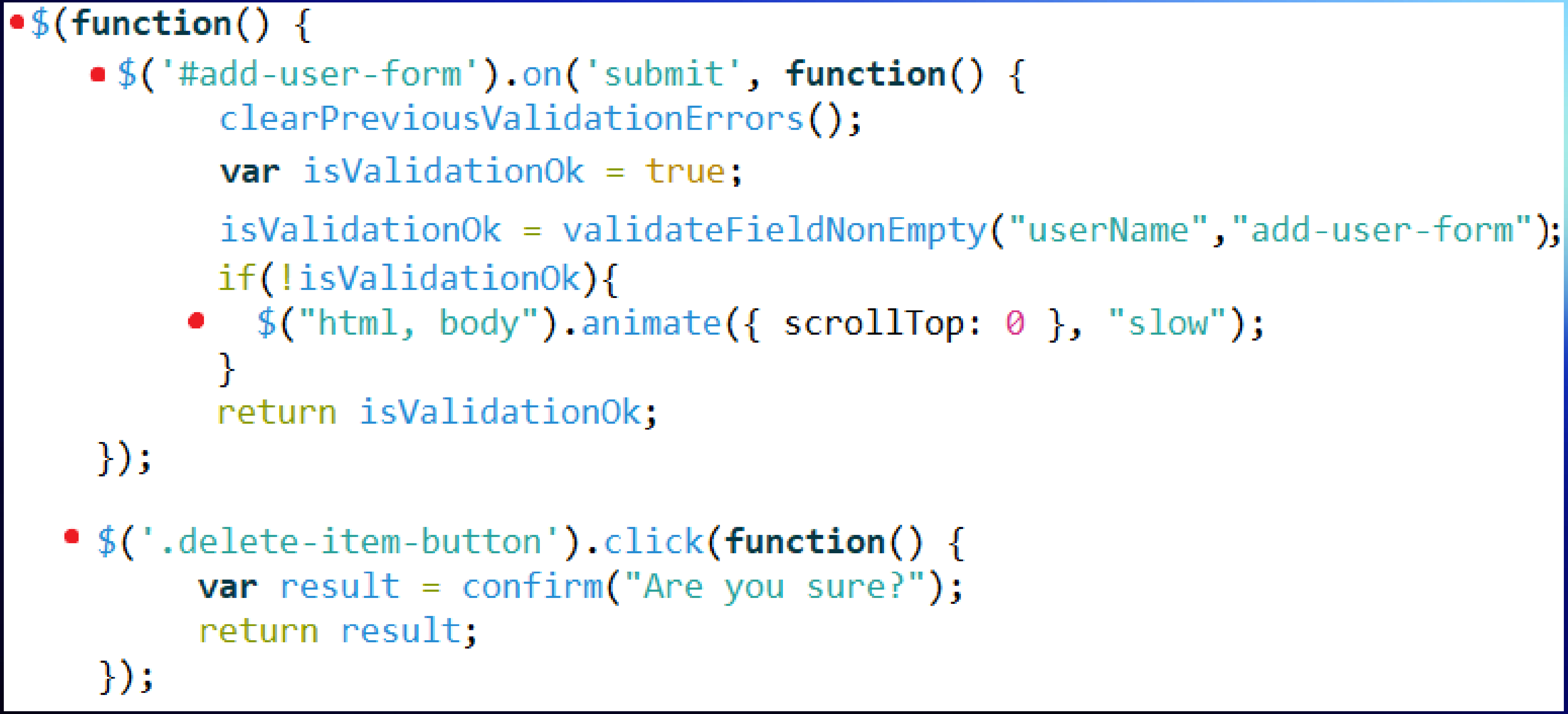
jQuery is a feature-rich JavaScript library.

It simplifies operations like: manipulation of HTML document (DOM operations), animations, event handling, AJAX.

Usually, no changes in HTML tags are required.

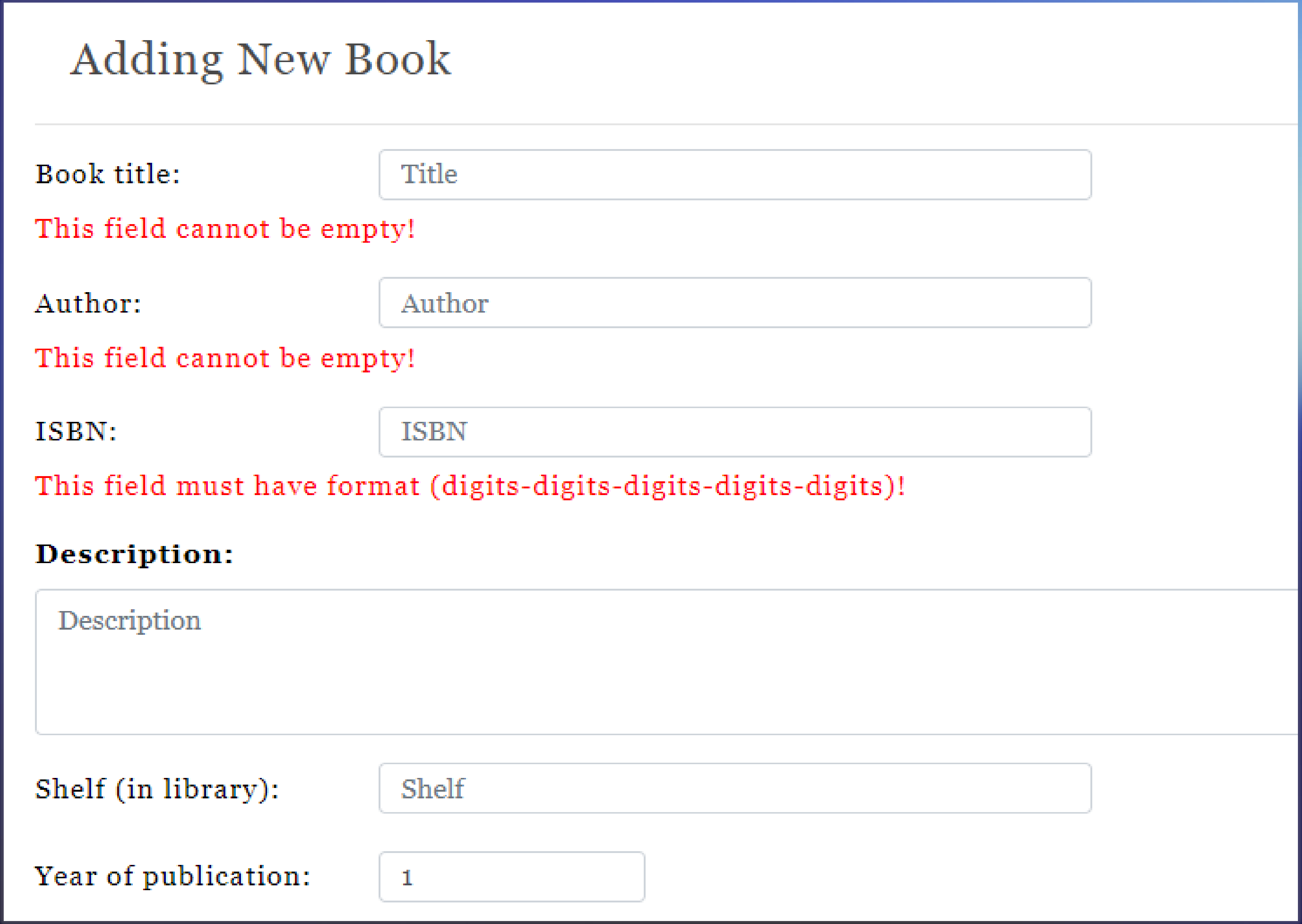
In our **Book Rental** application **JQuery helps us with form validation on client side.**

JQuery example



```
$(function() {
    $('#add-user-form').on('submit', function() {
         clearPreviousValidationErrors();
         var isValidationOk = true;
         isValidationOk = validateFieldNonEmpty("userName","add-user-form");
         if(!isValidationOk){
           $("html, body").animate({ scrollTop: 0 }, "slow");
         }
         return isValidationOk;
   });

   $('.delete-item-button').click(function() {
        var result = confirm("Are you sure?");
        return result;
   });
```

JQuery validate form



Adding New Book

Book title: Title

This field cannot be empty!

Author: Author

This field cannot be empty!

ISBN: ISBN

This field must have format (digits-digits-digits-digits-digits)!

Description:

Description

Shelf (in library): Shelf

Year of publication: 1

4

Questions

Bibliography

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