

# Assignment #5 - Library System Architecture

Software Systems Architecture

Alexandre Ferreira Nunes  
André Correia da Costa  
André Filipe Garcez Moreira de Sousa  
Daniel José Mendes Rodrigues  
Gonçalo da Costa Sequeira Pinto



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# 1 Introduction

Developing the architecture for an Automated Library System presents a complex challenge, demanding a balance between traditional library services and modern digital solutions. This report outlines our architectural design for such a system, addressing key functionalities like patron authentication, book check-out, catalog search, notification management, inventory control, media reservation, and collaboration with external libraries.

Our approach emphasizes principles such as Separation of Concerns and Appropriate Coupling, ensuring clear responsibilities for each module and flexible interactions between components. We will analyze typical scenarios to identify major modules and their connections, providing a blueprint for implementation and future enhancements.

As a collaborative group project, we aim to deliver an architecture that seamlessly integrates traditional library services with modern digital functionalities, empowering patrons and enhancing library management.

# 2 Simplified Relational Model

The relational model for the Automated Library System defines the interactions between various entities within the system. These interactions encompass the following aspects:

- **Patrons and Library Cards:** Patrons are associated with library cards, which serve as their accounts. They can use these cards to check out books by scanning them or entering credentials.
- **Book Checkout:** Patrons can check out books from the library.
- **Catalog Search:** Both patrons and staff can search the library catalog using criteria such as author, title, genre, popularity, and topic. This search functionality is available at designated stations within the library.
- **Notification Management:** Patrons receive notifications regarding late books and upcoming due dates.
- **Book Reservation:** Patrons can reserve books that other patrons currently check out.
- **Inventory Management:** The system includes functionality for managing inventory, including adding and removing books from the inventory.
- **Different Types of Media:** The library system accommodates various types of media, including physical books, magazines, DVDs, electronic books, etc.
- **Mobile Interaction:** Patrons can interact with the library system using their mobile phones, suggesting the presence of a mobile application or web interface.

- **Collaboration with Other Libraries:** Although the exact nature of collaboration with other libraries is unspecified, it implies interactions and data sharing between libraries.
- **Fines for Late Media:** Patrons incur fines for returning media past the due date.

The interactions between the described components, will be further elaborated and modeled in the relational schema, which will delineate the structure and relationships between entities within the Automated Library System.

It is important to note that the presented relational model serves as a simplified representation of the interactions within the Automated Library System. While not constituting the core architecture of the system, it has been included in our project to provide context and better contextualize the reader. By illustrating the relationships between key entities, the relational model aids in understanding the functional dynamics of the system. However, it should be understood that the relational model does not encompass all aspects of the system's architecture but rather complements it by highlighting essential interactions and data flows.

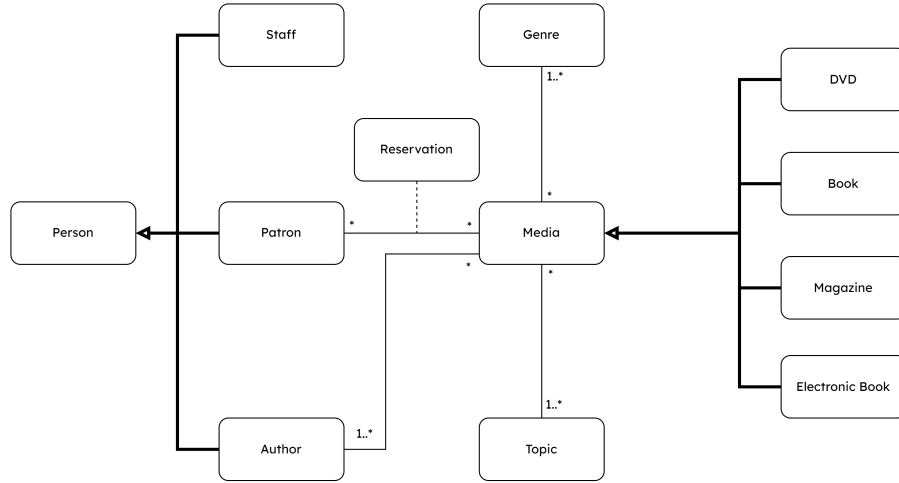


Figure 1: Relational Model

### 3 Physical Architecture Diagram

The physical architecture diagram offers a detailed view of the hardware components, network infrastructure, and deployment topology of the Automated Library System. This section's purpose is to provide stakeholders with insights into the operational environment of the system, as well as its main physical resources.

Bearing this in mind, we introduce in Figure 2 the Physical Diagram of our Library System. Our users are able to communicate with the main server of our application using the Internet. From that point, they can interact with all the libraries' servers as if they were one. Each library has its own database server, which not changed due to the integration with our system. Finally, we also continue supporting the local library users who use the libraries' terminals to interact with the system.

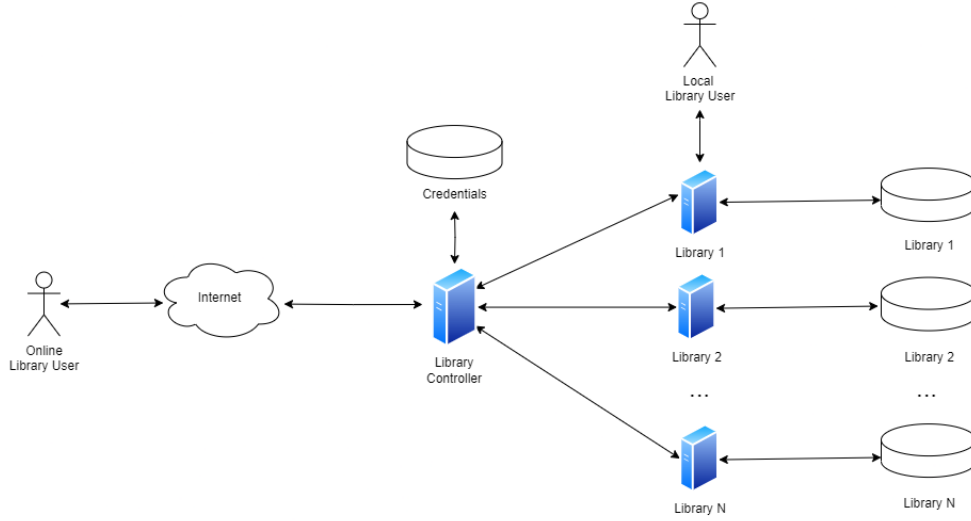


Figure 2: Physical Architecture

## 4 Architectural Diagram

The architectural diagram, presented in Figure 3, offers a visual representation of the Automated Library System's structural framework. It is a comprehensive overview of the system's core components, illustrating how they interact and collaborate to support various functionalities.

This diagram is a vital asset in our project, providing a clear blueprint for understanding the system's organization and operation. It highlights key modules such as patron authentication, book checkout, catalog search, notification management, and inventory control, showing how they are interconnected within the system.

With detailed annotations and labels, the architectural diagram aims to clarify design decisions and ensure a shared understanding among developers and stakeholders. It serves as a roadmap for implementation and future enhancements, guiding the development process towards a cohesive and functional system.

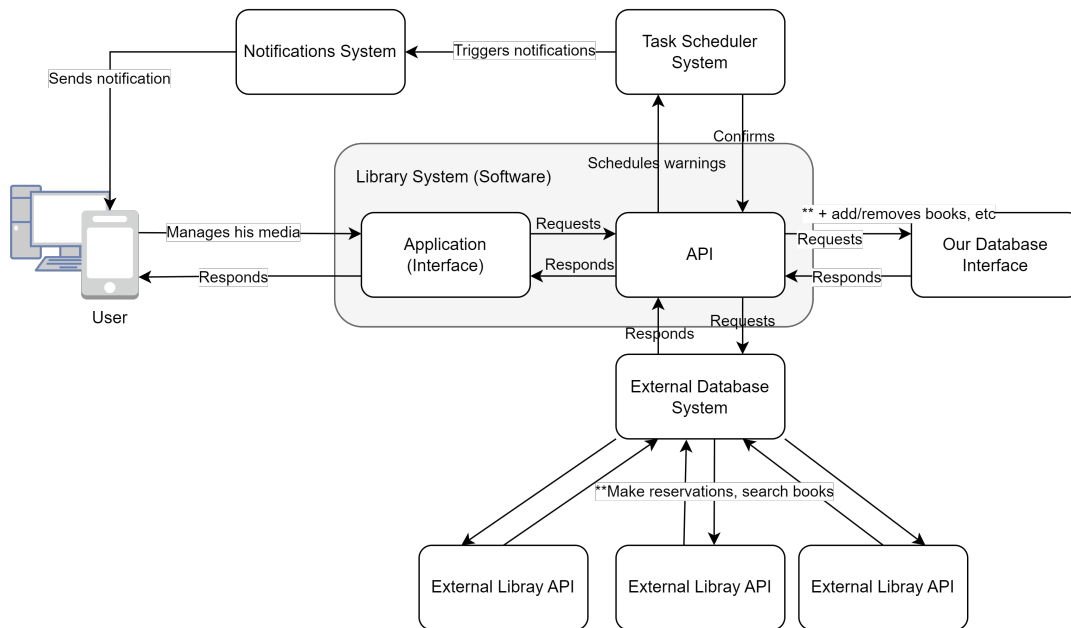


Figure 3: Architecture Diagram

The core of our system revolves around our comprehensive library management software. This software comprises an application that serves as the system interface, designed as a web application for universal accessibility across various platforms. This ensures users can access it seamlessly from any location and device. Additionally, the system incorporates an API responsible for managing all actions within the system.

In terms of data management, we maintain our dedicated database, offering features such as book reservations, search functionalities, and the ability to add or remove books. Furthermore, our system allows interaction with external libraries, though book addition or removal remains outside the scope of our interests in this regard. It’s worth noting that as we integrate with these external libraries, there will be no major changes to each library’s architecture, as our primary requirement is for them to expose an API, which most likely already exists, to our server. This approach ensures seamless integration without disrupting the existing functionality of these libraries.

To enhance user experience and system efficiency, we have implemented a task scheduler system within our API. This feature enables the scheduling of notifications for users, ensuring timely alerts about due dates, fines, and other pertinent information. For user notifications, a dedicated module is in place, providing flexibility for integration with external software through application notifications or email notifications as per user preferences. This modular approach ensures adaptability and seamless communication within our library sys-

tem.

## 5 Scenarios

In this section, we explore five key scenarios that illustrate the functionality and interaction of the Automated Library System. Each scenario presents a specific use case, demonstrating how patrons and staff members use the system to perform various tasks efficiently. Through these scenarios, we gain insight into the system's capabilities in managing library resources, handling user interactions, and facilitating collaboration with other institutions.

### 5.1 Patron reserves a fantasy book

In this scenario, a patron uses the online reservation feature to reserve a fantasy book. The sequence begins with the patron authenticating themselves with the library system. Once authenticated, the patron queries the library controller for available fantasy books.

The library controller forwards the query to multiple libraries, such as Library A and Library B, to search for the requested book. Both libraries respond with the search results, which are then relayed back to the patron by the library controller.

Upon finding the desired book, the patron chooses to reserve it. The patron sends a reservation request to the library controller, specifying the book they wish to reserve and the respective library.

The library controller processes the reservation request and forwards it to the specified library, which handles the reservation operation. Once the book is successfully reserved, the library's system notifies the library controller, which in turn informs the patron about the successful reservation.

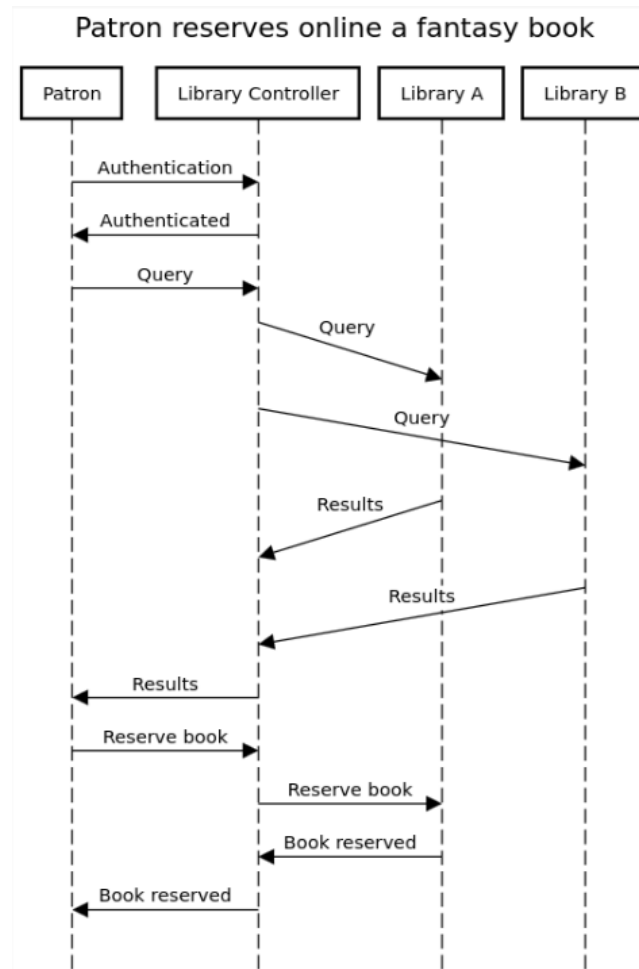


Figure 4: Scenario 1

## 5.2 Patron is fined for delivering the reserved book 3 days late

In this demonstrated process, a patron is fined for returning a reserved book late. The sequence begins with the patron authenticating themselves with the library system, ensuring that they have the necessary access to perform actions.

The patron delivers the reserved book, which triggers a request to the library controller to mark the book as delivered. The library controller forwards this request to Library A, the library from which the book was borrowed.

Library A acknowledges the book delivery and notifies the library controller about the late return. It provides information regarding the fine imposed on the patron due to the delayed return.



The library controller relays this information back to the patron, informing them about the fine incurred for returning the reserved book three days late. This sequence demonstrates the system’s capability to handle late returns and impose fines accordingly, ensuring accountability and adherence to library policies.

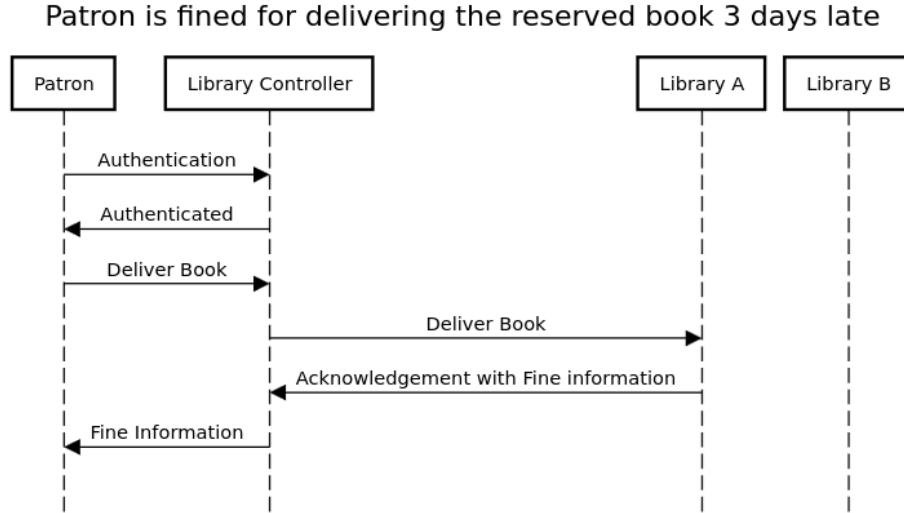


Figure 5: Scenario 2

### 5.3 A Patron is informed of the upcoming due date

In the following sequence, a patron is informed of an upcoming due date for a reserved book from Library B. The sequence begins with the patron initiating the book reservation process with Library B, possibly through an online reservation system.

After the reservation is confirmed, Library B notifies the Notification System about the reserved book. The Notification System, upon receiving this event, schedules a due date notification through the Task Scheduler.

Once the due date approaches and the scheduled timeout period elapses, the Task Scheduler triggers the notification process. It sends a due date notification to the patron, reminding them of the upcoming deadline for returning the reserved book.

A Patron is informed of the upcoming due date (Library B)

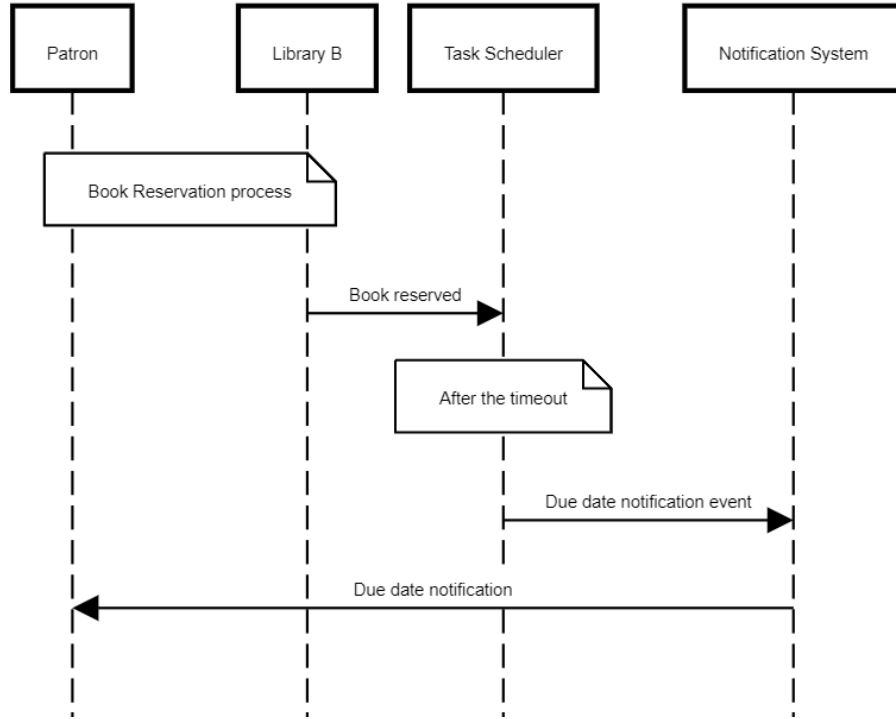


Figure 6: Scenario 3

#### 5.4 A Staff member adds a book to the catalog

The depicted scenario demonstrates, a staff member adding a book to the library catalog through an online process. The sequence starts with the staff members authenticating themselves with the library system to ensure proper authorization for performing administrative tasks.

Once authenticated, the staff member from Library A, submits a request to add a new book to the catalog through the Library Controller. The Library Controller processes the request and forwards it to Library A, which manages the catalog database.

Upon successful addition of the book to the catalog, Library A notifies the Library Controller about the completion of the operation. The Library Controller, in turn, informs the administrative staff or system administrator about the addition of the new book, ensuring that the catalog is updated and the book is available for patrons to access.

#### A Staff Member adds a book to the catalog (Online)

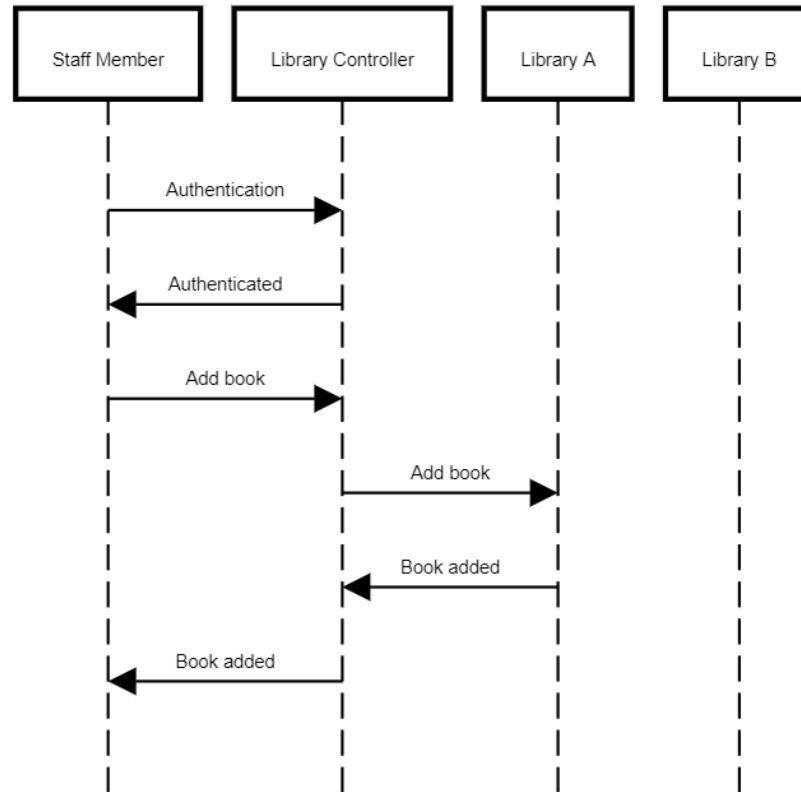


Figure 7: Scenario 4

### 5.5 Making a partnership with a university library

This scenario showcases the library system establishing a partnership with a new university library. The sequence begins with the new library providing necessary information through an entry form, which is received by an administrator responsible for partnership management.

The administrator validates the provided information to ensure its accuracy and relevance. Upon validation, the administrator forwards the relevant information to the Library Controller, the central component responsible for managing library operations.

The Library Controller processes the information and adds the new library to the options available within the system, enabling collaboration and resource sharing between the two libraries. The Library Controller then notifies the administrator about the successful addition of the new library.

Furthermore, the Library Controller informs the new university library about

the partnership, ensuring mutual acknowledgment and facilitating future co-operation. This sequence demonstrates the systematic process of establishing partnerships between libraries to enhance resource accessibility and promote collaboration within the library network.

### Making a partnership with a university library

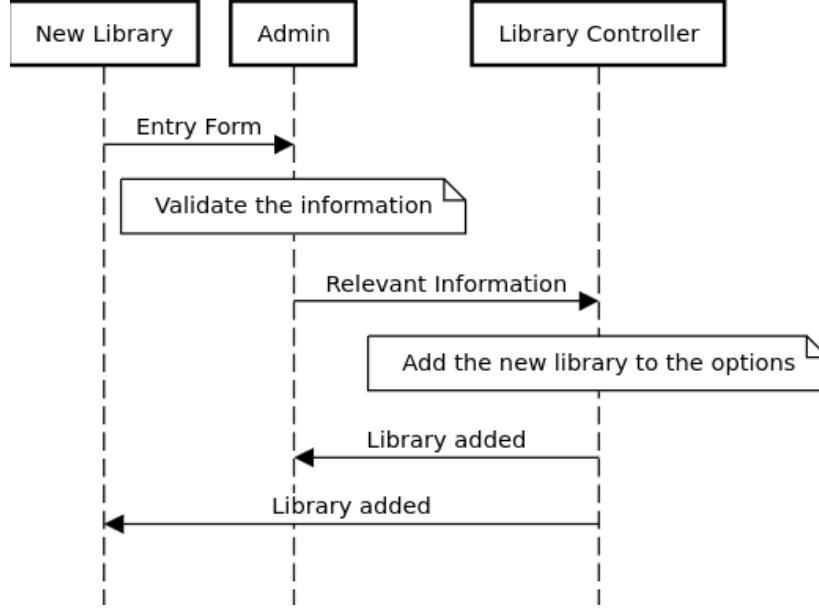


Figure 8: Scenario 5

## 6 Conclusion

In conclusion, the architectural design presented for the Automated Library System addresses the intricate challenges of integrating traditional library services with modern digital solutions. Throughout this report, we have outlined the core functionalities, interactions, and components of the system, providing a comprehensive blueprint for its implementation and future enhancements.

Our approach emphasizes principles such as Separation of Concerns and Appropriate Coupling to ensure clarity in module responsibilities and flexibility in component interactions. The simplified relational model illustrates the essential interactions within the system, aiding in understanding the functional dynamics. Additionally, the architectural diagram offers a visual representation of the system's structural framework, facilitating comprehension and guiding development efforts.

Through the exploration of key scenarios, we have demonstrated the system's capabilities in managing library resources, handling user interactions, and faci-

tating collaboration with external institutions. These scenarios provide concrete examples of how patrons and staff members interact with the system to perform various tasks efficiently.

Overall, our collaborative effort aims to deliver an architecture that seamlessly integrates traditional library services with modern digital functionalities, empowering patrons and enhancing library management. As technology continues to evolve, we anticipate further refinements and enhancements to the Automated Library System, ensuring its continued relevance and effectiveness in meeting the needs of library users and administrators alike.