

Library Management System with Recommendation Engine

Submitted in the partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

In

Computer Science And Engineering

Specialized In

Artificial Intelligence And Machine Learning

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Outline

- Project Introduction
- Problem Formulation
- Project Objectives
- Methodology
- Outputs Of Result
- Conclusion
- Future Scope
- References

Project Introduction

An Interactive Library Management System With
Real-Time Book Recommendation



ATHENAEUM

Project Features

→ Database Management Solution For Library

Atheneum provides a intuitive UI to manage Books, Activities, staff members and members of the library.

→ Individual Book Recommendation

Atheneum recommends books to the based on previously collected user data.

→ Scalable Over LAN and Platform Independent

Atheneum is moderately scalable too.

Project Features

→ Three Different Access Levels For Users

→ Admins

- Add Or Update Users for All Access Levels
- Add or Update Books
- Issue Or Return Books

→ Curators Or Moderators

- Issue Or Return Books
- View Currently Issued Books
- Issuance History

→ Members Or Users

- View Books
- Receive Recommendation Based On Their Data

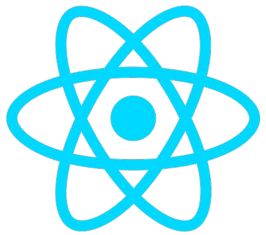
Technological Architecture

Frontend \longleftrightarrow Backend \longleftrightarrow Database



Redux JS

+



React JS



Or



Problem Formulation

→ Management System

Creation of Database Solution For Library With Different Access Levels

→ Book Recommendations

To recommend books, ratings for each book in the available data has been predicted and recommendations

Objectives Of Management System

- The Efficient Management of Huge Libraries with a lot of books along with their information and overwhelming number of users
- Optimized and Intuitive User Interface for admins and curators to make their life less stressful



Objectives Of Recommendation Engine

- **Quality Recommendation** for user from plethora of books available.
- Helping user to find **The Next Best Read For Them** which would increase their happiness index and quality of life.



Objectives Of Web Application

- **Scalable Application** so that it can be accessed over a LAN or organization's network
- **Easy To Deploy Application** for the user-experience of network administrator of the organization
- **Platform Independent Application** as there are only two prerequisites,i.e. a web browser and user's presence on the same network



Aim Of Atheneum



Improved Quality Of Life
For All Of Its Users
Be It Readers, Curator Or Admin



Methodology

Different methodologies have adopted for development each major component of the application. Those components are :

- Frontend
- Backend
- Recommendation Engine
- Full-stack Integration

All major components have been developed concurrently over the course of semester.

Methodology for Frontend

- Creation of Mockups
- Install prerequisite dependencies
- Setting up React with npx
- Setting up Redux Dev tools for debugging
- Set up Redux store for State management
- Creation of Components
- Implementation of Layout

Methodology for Backend

- Creation of a plan of action to proceed
- Set up directories
- Initiate Django Project
- Initiate Django apps for each API
- Implement three APIs (mainapp, users, library)
- Load and Integrate ML model
- Test Each API for required output

Methodology for Recommendation Engine And Full-stack Integration

→ Recommendation Engine

- Acquiring knowledge about existing systems
- Dataset Retrieval and Synthetic feature generation
- Data Preparation & Model Creation
- Saving Model in joblib file

→ Full-stack Integration

- Apply middlewares to Django project
- Set up routes and URLs in django and react project
- Creation of Reducers in react app
- Setting up hooks for API calls in react app

FrontEnd :-

- For FrontEnd we use **react, nodejs**.
- **Redux dev tool** is used for monitoring.
- For store and retrieve model **Joblib** is used.

BackEnd :-

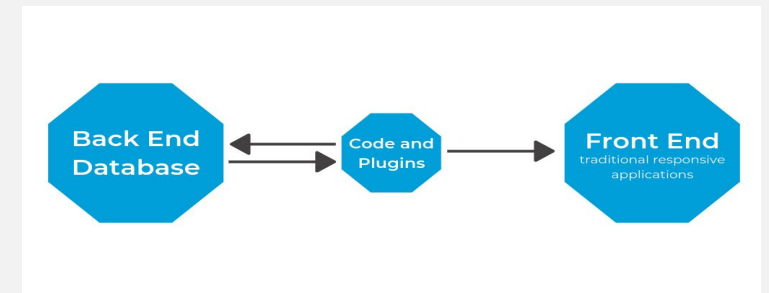
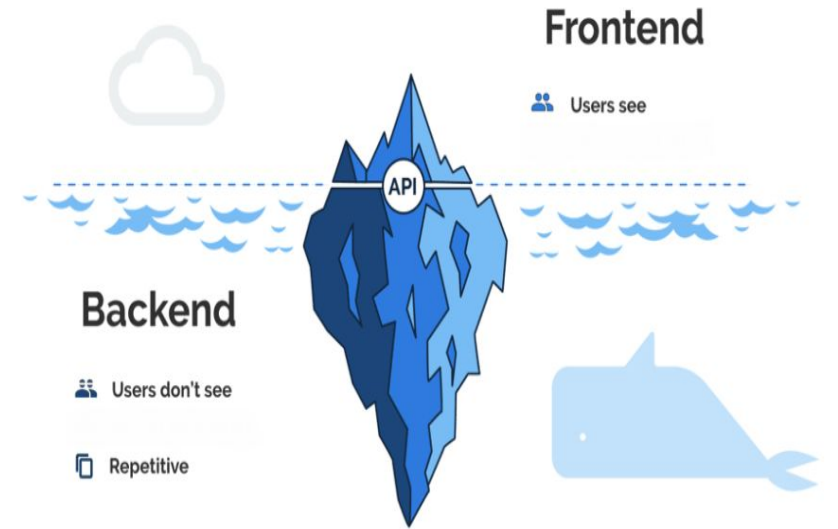
- For BackEnd we use **Python, django**.
- **PostgresSQL/SQL Database** used as a database.

Recommendation Engine :-

- For Recommendation Engine we use **Python**.
- Library used - **numpy, pandas, sklearn** and **Surprise**.

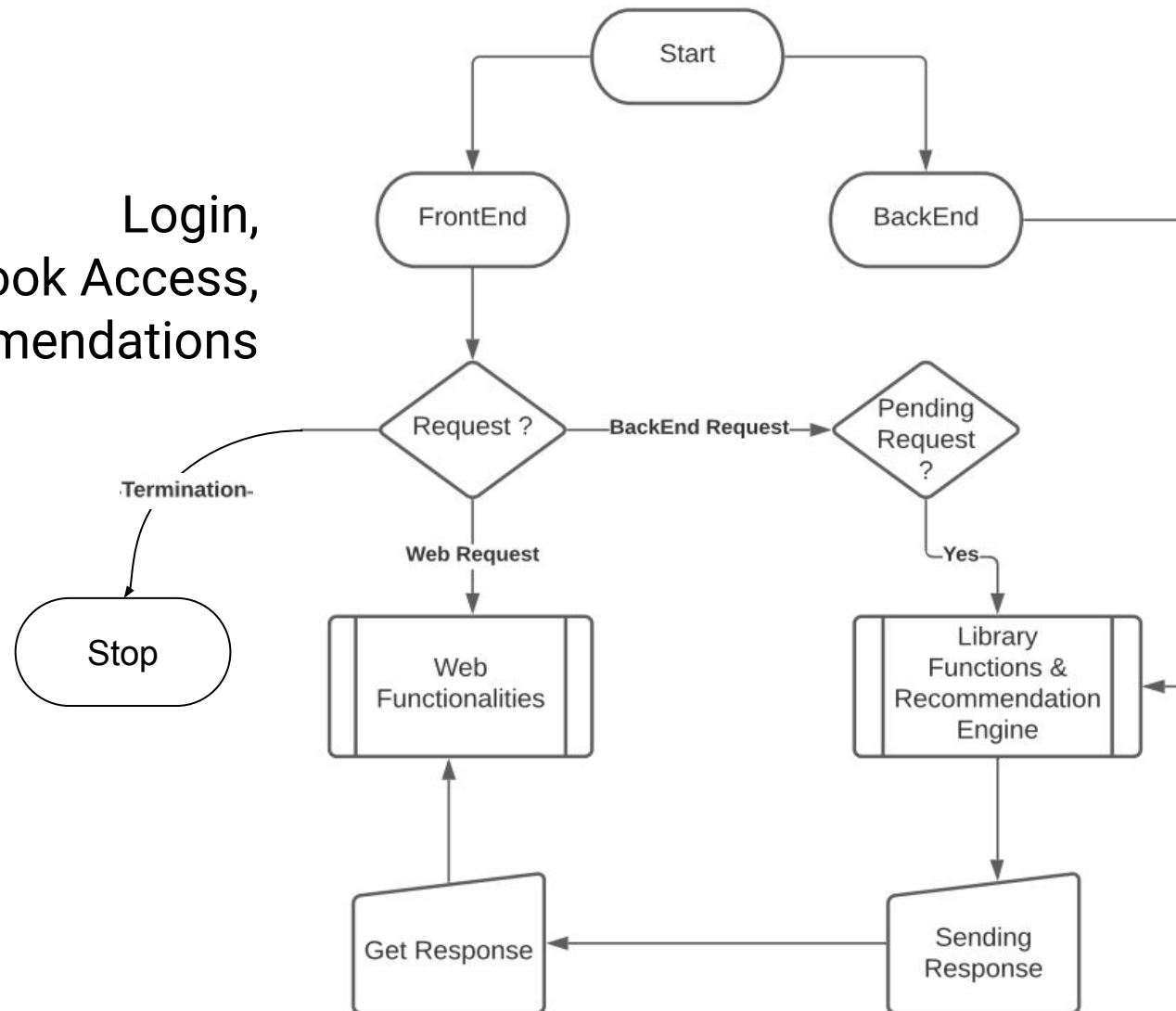
To connect Backend and Frontend :-

- **CORS** middleware.



Flow Of Application

Login,
Book Access,
Get Recommendations



Dataset And Recommendation Engine

→ Dataset Retrieval And Preparation

Current implementation uses a extended book crossing dataset with kaggle's book summary dataset with synthetic features.

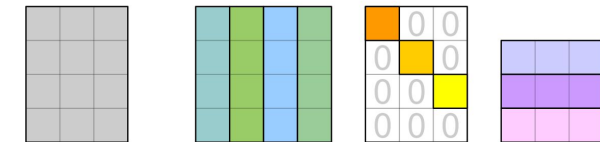
→ Recommendation Engine Algorithm

The Engine employes matrix factorization to predict ratings for individual users based on user data.

Recommendation Engine Algorithm

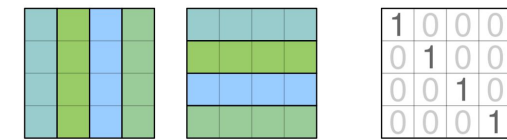
→ **Matrix Factorization** is a class of collaborative filtering algorithms. It decomposes the user-item interaction matrix into the product of two lower dimensionality matrices.

→ Current implementation of user-item interaction matrix is user x books matrix.



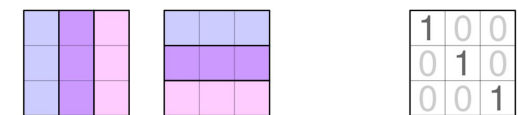
$$\begin{matrix} \mathbf{M} & = & \mathbf{U} & \mathbf{\Sigma} & \mathbf{V}^* \\ m \times n & & m \times m & m \times n & n \times n \end{matrix}$$

M is $m \times n$ user-item interaction matrix that decomposes into U and V



$$\mathbf{U} \mathbf{U}^* = \mathbf{I}_m$$

U is $m \times m$ orthonormal matrix



$$\mathbf{V} \mathbf{V}^* = \mathbf{I}_n$$

V is $n \times n$ orthonormal matrix

Outputs Of Result

- Login Page
- User Home Page
- Recommendations Page
- Update Password Page
- Admin Home Page
- Issue Book Dialog
- Return Book Dialog
- Features Of Admin Panel Page
- List Of Database Tables
- Accessing App Over LAN On Mobile

Login Page



Sign in

UserName *

user

Password *

••••••••

SIGN IN



ATHENEUM_2021.

User Home Page


[RECOMMENDATION](#)
[UPDATE PASSWORD](#)
[LOGOUT](#)


Books in LIBRARY

 Search


ID	Title	Genre	Author	Status	URL
5	Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future	'Biography'	Ashlee Vance	Available	https://www.amazon.com/Elon-Musk-SpaceX-Fantastic-Future/dp/006230125X
4	Freakonomics	'Economics'	Steven Levitt	Available	https://www.google.co.in/books/edition/Freakonomics/kxsQhM4D8uIC?hl=en&gbpv=1&printsec=frontcover
3	Harry Potter And The Philosopher's Stone	"Children's Book", 'Fiction', 'Novel'	J.K Rowling	Available	https://images.unsplash.com/photo-1600431521340-491eca880813?ixid=MnwxMjA3fDB8MHxwaG90by1wYWdlfHx8fGVufDB8fHx8&ixlib=rb-1.2.1&auto=format&fit=crop&w=750&q=80
2	Rich Dad, Poor Dad	'Economics'	Robert Kiyosaki	Available	https://images.unsplash.com/photo-1600431521340-491eca880813?ixid=MnwxMjA3fDB8MHxwaG90by1wYWdlfHx8fGVufDB8fHx8&ixlib=rb-1.2.1&auto=format&fit=crop&w=750&q=80
1	Think And Grow Rich	'Reference work', 'Self-help'	Napolean Hill	Available	https://images.unsplash.com/photo-1600431521340-491eca880813?ixid=MnwxMjA3fDB8MHxwaG90by1wYWdlfHx8fGVufDB8fHx8&ixlib=rb-1.2.1&auto=format&fit=crop&w=750&q=80

|< < 1-5 of 5 > >|

Recommendation Page

ATHENIUM

RECOMMENDATION | UPDATE PASSWORD | LOGOUT

Books in LIBRARY

ID	Title
5	Elon Musk: Test the Quest for a
4	Freakonomics
3	Harry Potter And Philosopher's S
2	Rich Dad, Poor
1	Think And Grow

Your Next Favourite Book Could Be

The Satan Bug

Genre : Thriller
Rating :4.9

Summary

the story revolves around the theft of two germ warfare agents botulinum toxin and the indestructible satan bug a laboratory conceived derivative of poliovirus from the mordon microbiological research establishment similar to porton down there is no vaccine for the satan bug and it is so infectious that any release will rapidly destroy all human life on earth with these phials of unstoppable power a mad environmentalist threatens the country s population unless mordon is razed to the ground like other of maclean s works the plot involves layers of deception both of the nominal antagonists and of the reader the first person narrator pierre cavell is initially presented as an embittered figure who has been successively fired for insubordination from the army the metropolitan police and from mordon itself cavell is called in by former colleagues at special branch after being tested with a bribe to ensure that he is still honest the novel gradually reveals that for the past years cavell has in fact been working for the general apparently a senior intelligence director and cavell s father in law and

GET ANOTHER RECOMMENDATION

/dp/006230125X

M4D8uIC?

80813?

&ixlib=rb-

80813?

&ixlib=rb-

80813?

&ixlib=rb-

< 1-5 of 5 > >|

Update Password Page

[RECOMMENDATION](#)[UPDATE PASSWORD](#)[LOGOUT](#)

Update Password

UPDATE PASSWORD

ATHENEUM_2021.

Admin Home Page

[ISSUE/RETURN](#)[ADMIN PANEL](#)[UPDATE PASSWORD](#)[LOGOUT](#)

Issue Records


[ALL BOOKS](#)[CURRENTLY ISSUED](#)[ISSUE HISTORY](#)

ID	IssuedAt	Book	Issued_To
22	2021-04-27 @ 18:30	Freakonomics	Piyush

|< < 1-1 of 1 > >|

ATHENEUM_2021.

Issue/Return Book Dialog

ATHENEUM

ISSUE/RETURNADMIN PANELUPDATE PASSWORDLOGOUT

Books in LIBRARY

Q SearchX

ALL BOOKSCURRENTLY ISSUEDISSUE HISTORY

ID	Title	Genre
5	Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future	'Biography'
4	Freakonomics	'Economics'
3	Harry Potter And The Philosopher's Stone	"Children's Book", 'Fiction', 'Novel'
2	Rich Dad, Poor Dad	'Economics'
1	Think And Grow Rich	'Reference work', 'Self-help'

Issue Or Return A BookX

Book id *
4

Borrower Details *
Piyush

ISSUE BOOKRETURN BOOK

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Features Of Admin Panel & List Of Database Tables

Atheneum iLMS

WELCOME, ADMIN. [VIEW SITE](#) / [CHANGE PASSWORD](#) / [LOG OUT](#)

[Home](#) > [Library](#) > [Books](#) > [Add book](#)

AUTH TOKEN

Tokens [+ Add](#)

AUTHENTICATION AND AUTHORIZATION

Groups [+ Add](#)

Users [+ Add](#)

LIBRARY

Authors [+ Add](#)

Books [+ Add](#)

Categories [+ Add](#)

Add book

Title:

The Hard Thing About Hard Things

Author:

Categories:

Biography

Children's Book

Economics

Fiction

Novel

Reference work

Self-help

☒ Status b

Phy rack:

1

Book url:

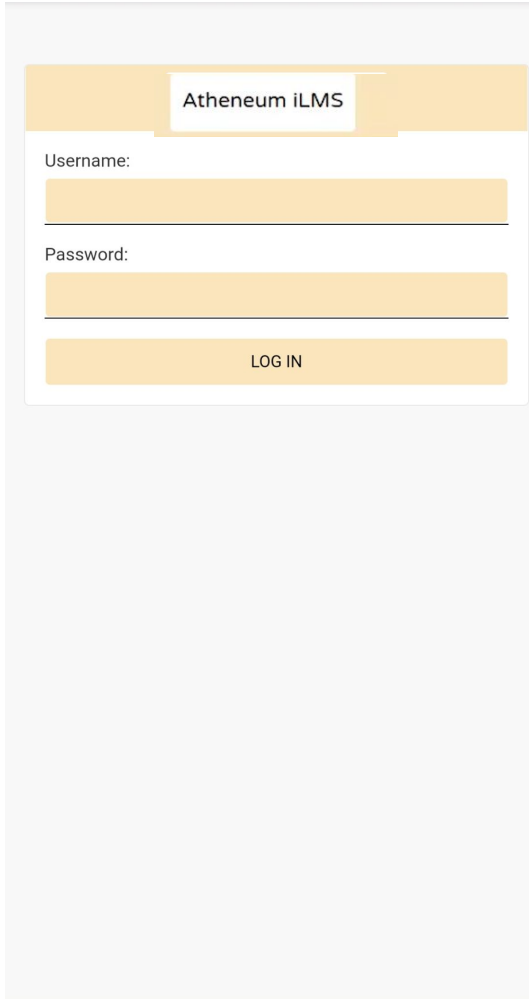
Currently: <https://images.unsplash.com/photo-1600431521340-491eca880813?ixid=MnwzMjA3fDB8MHxwaG90by1wYWdlfHx8fGVufDB8fHx8&ixlib=rb-1.2.1&auto=format&fit=crop&w=750&q=80>

Change: <https://images.unsplash.com/photo-1600431521340-491eca880813>

- Tables (17)
 - auth_group
 - auth_group_permissions
 - auth_permission
 - auth_user
 - auth_user_groups
 - auth_user_user_permissions
 - authtoken_token
 - django_admin_log
 - django_content_type
 - django_migrations
 - django_session
 - library_author
 - library_book
 - library_book_categories
 - library_category
 - library_issued_records
 - library_logofissued

Accessing App Over LAN On Mobile

The Application isn't
responsive yet

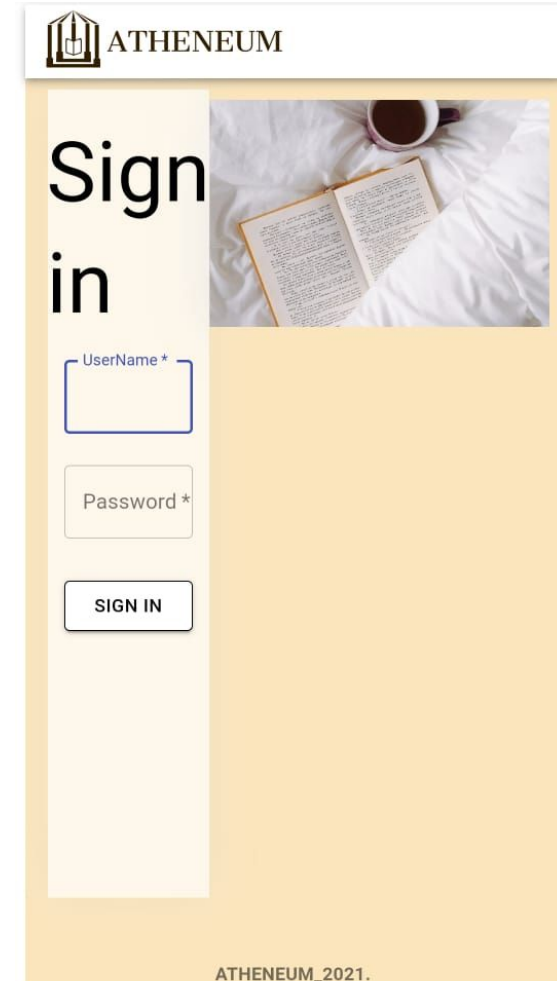


Atheneum iLMS

Username:


Password:

LOG IN



ATHENEUM

Sign
in



UserName *

Password *

SIGN IN

ATHENEUM_2021.

Conclusion

- The App can be used to manage a Library Efficiently and recommend books as well.
- One Drawback of this App is it is not yet optimized for other Devices. App looks better in PCs and not so much in smartphones.

Future Scope

- The App can be used to make a perfect Library if the below mentioned points are achieved.
 - The App can be optimized for Other Devices.
 - Recommendation engine to be made dynamic by defining regular updation (training) periods
 - The Application can be made scalable over the internet

References

- React documentation : <https://reactjs.org/docs/getting-started.html>
- Django documentation : <https://docs.djangoproject.com/>
- Pipenv documentation : <https://pipenv-fork.readthedocs.io/en/latest/>
- VirtualEnv documentation: <https://virtualenv.pypa.io/en/latest/>
- Django React Tutorial : [Tutorial](#)
- Joblib : [Blog](#)

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- Manning, C.D., Raghavan, P., & Schutze, H. (2008). " Introduction to information retrieval. New York: Cambridge University Press.
- Yehuda Koren, Robert Bell, and Chris Volinsky. 2009. Matrix factorization techniques for recommender systems. Computer, (8):30–37.

Thank You