BOOK RECOMMENDATION SYSTEM

A COURSE PROJECT REPORT

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(Under Section 3 of UGC Act, 1956)

BONAFIDE CERTIFICATE

Certified that this mini project titled "**Book Recommendation System"** is the bonafide work of **Sonal Shabir (RA2011027010010), Prakhar Srivastava (RA2011027010013), and Shreya Dutta (RA2011027010033)** who carried out the project work under my supervision.

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ABSTRACT

Today the amount of information on the internet grows very rapidly and people need some instruments to find and access appropriate information. One of such tools is called a recommendation system.

Recommendation system is a subclass of Machine Learning which deals with the ranking or rating products or users. It is a tool that helps to navigate quickly and receive necessary information.

Now-a-days, online ratings, and reviews play an important role in book sales. readers buy books depending on choices made by other customers. Our Recommendation system focuses on these reviews and ratings by others and filters books according to the user's preferences.

This project proposes a quick and intuitive Book Recommendation System that helps readers to find the appropriate book, to read next. The overall architecture is presented with its detailed description. We used a collaborative filtering.

Most of the existing services need a profile history information and other information that need some time to provide users with recommendations while our aim was to generate recommendations for users in a very quick way. This project provides a system with the advantage of speed and simplicity.

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1. INTRODUCTION

1.1 Scenario Description

Nowadays the amount of information on Internet is vast. Finding necessary information becomes more difficult. Recommendation systems aim to solve this kind of problems. With the help of them one can quickly access relevant information without searching the web manually. As such many web sites today benefit from recommendation systems to promote and sell their products. There is a wide range of products like music, movies, articles etc., that can be recommended to the customer based on their profiles in internet shops or even social networks, browsing history such as visited links, browsing activity like number and time of visits and other online behavior.

1.2 Objective

In this project we propose the idea of using recommendation systems for recommending books. We developed a system, which learns user preferences by asking to rate books and choosing favorite categories and then generate the list of books user most probably would like to read. The ratings and the number of reads each book has plays an important role for recommending books in our project. The objectives of the project includes:

i. To study the techniques used to build the book recommendation system.

ii. Formulate a plan with gathering proper number of resources and proper amount of data.

iii. Build the model using proper algorithm.

iv. Analyze the accuracy and results of the model.

2. LITERATURE SURVEY

1. Book Recommendation System through Content Based and Collaborative Filtering Method

Ms. Praveena Mathew, Ms. Bincy Kuriakose, Mr.Vinayak Hegde
Department of Computer Science Amrita Vishwa Vidyapeetham Mysuru, Karnataka, India

Recommendation system is widely used from the last decades. Book recommendation system is recommending books to the buyers that suits according to their interest and stores recommendations in the buyer's web profile. This system will store the details of the books which users have bought earlier and find the category of book from users buying history. It uses content based filtering and collaborative filtering to find out the list of books based on content and ratings. The system actually evaluates the quality of the recommending books dependent on the rating given by the existing users also use association rule mining algorithm to finds interesting association and relationship among large data set of books and provide an efficient recommendation for the book. This system may be helpful for lots of people as well as students who need the best books available from the database for both general and academic purpose.

2. Book Recommendation System

Ms. Sushama Rajpurkar, Ms. Darshana Bhatt and Ms. Pooja Malhotra
Department of Information Technology KJSCE, Vidyavihar(E), Mumbai, India

The goal of the most recommendation system is to predict the buyer's interest and recommends the books accordingly. This book recommendation has considered many parameters like content of the book and quality of the book by doing collaborative filtering of ratings by the other buyers. This recommender system also uses associative model to give stronger recommendations. This system does not have performance problem since it built the recommendations offline.

3. A Novel Approach for Book Recommendation Systems

P Devika, R C Jisha and G P Sajeev

Department of Computer Science and Engineering Amrita School of Engineering, Amritapuri, Amrita Vishwa Vidyapeetham, Amrita University, India

This paper has proposed a novel framework for recommendation system by utilizing an FP Intersect algorithm. The system uses the information obtained after analyzing the opinions of each user from the user comments. The user ratings and their comments are extracted from the user reviews. Score is calculated by considering the polarity of user comments and average of ratings, each book is included in the record depending on the score for recommendation. The proposed system overcomes the drawback of Apriori by reducing the number of scans and generates association rules. The work could be enhanced in future by considering some concept generation approaches rather than dealing with keywords to provide recommendations.

4. Book Recommendation System Using Machine Learning

Authors: Prof. S. R. Hiray, Mr. Atish Bhosale, Ms. Komal Patil, Ms. Amruta Gaikwad, Mr. Riddhesh Deshmukh

In this paper, a recommendation system based on a collaborative filtering approach was presented. The main goal was to speed up recommendations which is to create such a system, which can provide quality recommendations to their users without the need for long-term registration and have a great profile experience, browsing history etc. Test results indicate that the proposed approach provides appropriate recommendations. The proposed activity can be used in other domains to promote such things as movies, music, and other products. This approach uses a shared filtering algorithm that filters books based on user ratings and recommendations. The process takes user ratings and user feedback to consider recommending letters to users.

5. Collaborative Filtering Recommender Systems

J. Ben Schafer, Dan Frankowski, Jon Herlocker, and Shilad Sen

Collaborative filtering is one of the core technologies that will power the adaptive web. Content-based personalization can be effective in limited circumstances, but for the most part, it will likely be decades or longer before our hardware and software technology can begin to automatically recognize the subtleties of information that are important to people – particularly aspects of aesthetic taste. Until then, to filter information based on such complex dimensions, we need to include people in the loop, who analyze the information and condense their opinions into data that can be easily processed by software – ratings. In this chapter, we have attempted to provide a snapshot of the current understanding of collaborative filtering systems and methods. By necessity, as masses of information become ubiquitously available, collaborative filtering will also become ubiquitous. In the process, we will continue to gain a deeper understanding of the dynamics of collaborative filtering.

6. A Detailed Study of Clustering Algorithms

Kamalpreet Bindra and Anuranjan Mishra
CSE Department, Noida International University

Cluster analysis is a very crucial paradigm in the entire process of data mining and paramount for capturing patterns in data. This paper compared and analyzed some highly popular clustering algorithms where some are capable of scaling and some of the methods work best against noise in data. Extensive research proved that there is an alarming need of some sort of benchmark for the researchers to be able to measure efficiency and validity of diverse clustering paradigms. The criteria should include data from diverse domains. Not just a measure for benchmarking algorithms, consistent and stable clustering is also a barrier as a clustering algorithm irrespective of its approach towards handling static or dynamic data should produce consistent results with complex datasets.

3. REQUIREMENTS

3.1 Requirement Analysis

For the project, we draw the following requirements:

1. Identifying the proper IDE (Integrated Development environment) to be used, in this case being Jupyter Notebook.
2. Proper analysis of problem statement and requirements.
3. Gathering of data and resources.
4. Choose the appropriate Machine Learning algorithm to build the project model.
5. Ensuring well written and error free codes.
6. Analyzing the results properly and testing the model on various new data.

3.2 Software Skills Requirement

The Software skills or tools needed for this project are:

1. Familiar with using Jupyter Notebook in the Conda environment.

2. Proper knowledge of Machine Learning algorithms to figure out the appropriate knowledge to be used like Clustering and Collaborative filtering.

3. Fluent with python programming language and its libraries.

4. Proper knowledge of Data processing and manipulating commands.

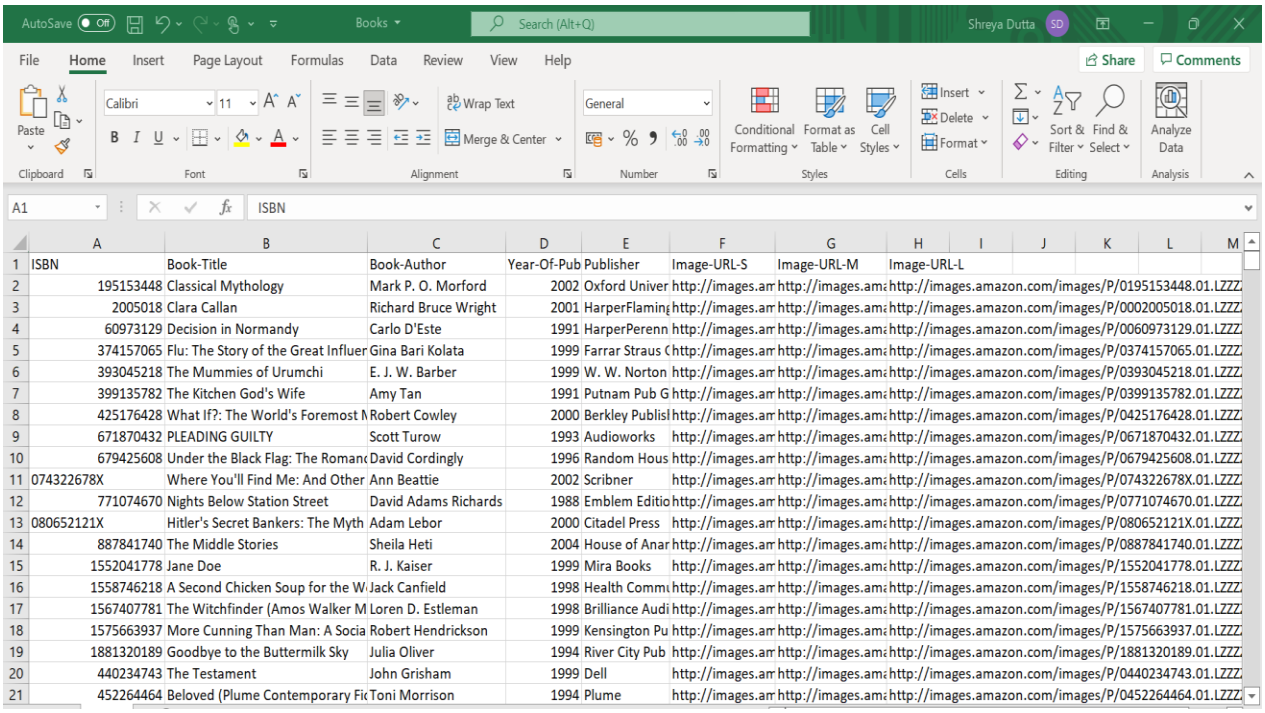
5. Knowledge of Flask to integrate the frontend of the website application.

4. DATA SET DESCRIPTION

For this project, we used an online available data set from Kaggle.com. There are a total of three data sets used for this project. One data set includes all the books, names of authors, images, and year of publication called “Books.csv”. The second dataset contains all the information related to the users, that is the people who read the books, called “Users.csv”. The third dataset contains the ratings for every book, called “Ratings.csv”.

The “Books.csv” data set contains the ISBN number of the book, Book Title, Book Author, Year of Publication, Publisher, Image URL of the cover page of the book. The ISBN as well as Year of Publication column has the data type of integer, Book Title, Book Author, Publisher, and Image URL columns are of type string.

Below is the “Books.csv” file on excel as well as the Jupyter Notebook:



	A	B	C	D	E	F	G	H
1	ISBN	Book-Title	Book-Author	Year-Of-Pub	Publisher	Image-URL-S	Image-URL-M	Image-URL-L
2	195153448	Classical Mythology	Mark P. O. Morford	2002	Oxford Univer	http://images.am	http://images.am	http://images.amazon.com/images/P/0195153448.01.LZZZ
3	2005018	Clara Callan	Richard Bruce Wright	2001	HarperFlamin	http://images.am	http://images.am	http://images.amazon.com/images/P/0002005018.01.LZZZ
4	60973129	Decision in Normandy	Carlo D'Este	1991	HarperPerenn	http://images.am	http://images.am	http://images.amazon.com/images/P/0060973129.01.LZZZ
5	374157065	Flu: The Story of the Great Influer	Gina Bari Kolata	1999	Farrar Straus (	http://images.am	http://images.am	http://images.amazon.com/images/P/0374157065.01.LZZZ
6	393045218	The Mummies of Urumchi	E. J. W. Barber	1999	W. W. Norton	http://images.am	http://images.am	http://images.amazon.com/images/P/0393045218.01.LZZZ
7	399135782	The Kitchen God's Wife	Amy Tan	1991	Putnam Pub G	http://images.am	http://images.am	http://images.amazon.com/images/P/0399135782.01.LZZZ
8	425176428	What If?: The World's Foremost M	Robert Cowley	2000	Berkley Publis	http://images.am	http://images.am	http://images.amazon.com/images/P/0425176428.01.LZZZ
9	671870432	PLEADING GUILTY	Scott Turow	1993	Audioworks	http://images.am	http://images.am	http://images.amazon.com/images/P/0671870432.01.LZZZ
10	679425608	Under the Black Flag: The Romanc	David Cordingly	1996	Random Hous	http://images.am	http://images.am	http://images.amazon.com/images/P/0679425608.01.LZZZ
11	074322678X	Where You'll Find Me: And Other	Ann Beattie	2002	Scribner	http://images.am	http://images.am	http://images.amazon.com/images/P/074322678X.01.LZZZ
12	771074670	Nights Below Station Street	David Adams Richards	1988	Emblem Editio	http://images.am	http://images.am	http://images.amazon.com/images/P/0771074670.01.LZZZ
13	080652121X	Hitler's Secret Bankers: The Myth	Adam Lebor	2000	Citadel Press	http://images.am	http://images.am	http://images.amazon.com/images/P/080652121X.01.LZZZ
14	887841740	The Middle Stories	Sheila Heti	2004	House of Anar	http://images.am	http://images.am	http://images.amazon.com/images/P/0887841740.01.LZZZ
15	1552041778	Jane Doe	R. J. Kaiser	1999	Mira Books	http://images.am	http://images.am	http://images.amazon.com/images/P/1552041778.01.LZZZ
16	1558746218	A Second Chicken Soup for the W	Jack Canfield	1998	Health Comm	http://images.am	http://images.am	http://images.amazon.com/images/P/1558746218.01.LZZZ
17	1567407781	The Witchfinder (Amos Walker M	Loren D. Estleman	1998	Brilliance Audi	http://images.am	http://images.am	http://images.amazon.com/images/P/1567407781.01.LZZZ
18	1575663937	More Cunning Than Man: A Socia	Robert Hendrickson	1999	Kensington Pu	http://images.am	http://images.am	http://images.amazon.com/images/P/1575663937.01.LZZZ
19	1881320189	Goodbye to the Buttermilk Sky	Julia Oliver	1994	River City Pub	http://images.am	http://images.am	http://images.amazon.com/images/P/1881320189.01.LZZZ
20	440234743	The Testament	John Grisham	1999	Dell	http://images.am	http://images.am	http://images.amazon.com/images/P/0440234743.01.LZZZ
21	452264464	Beloved (Plume Contemporary Fic	Toni Morrison	1994	Plume	http://images.am	http://images.am	http://images.amazon.com/images/P/0452264464.01.LZZZ

```
In [3]: books.head()
```

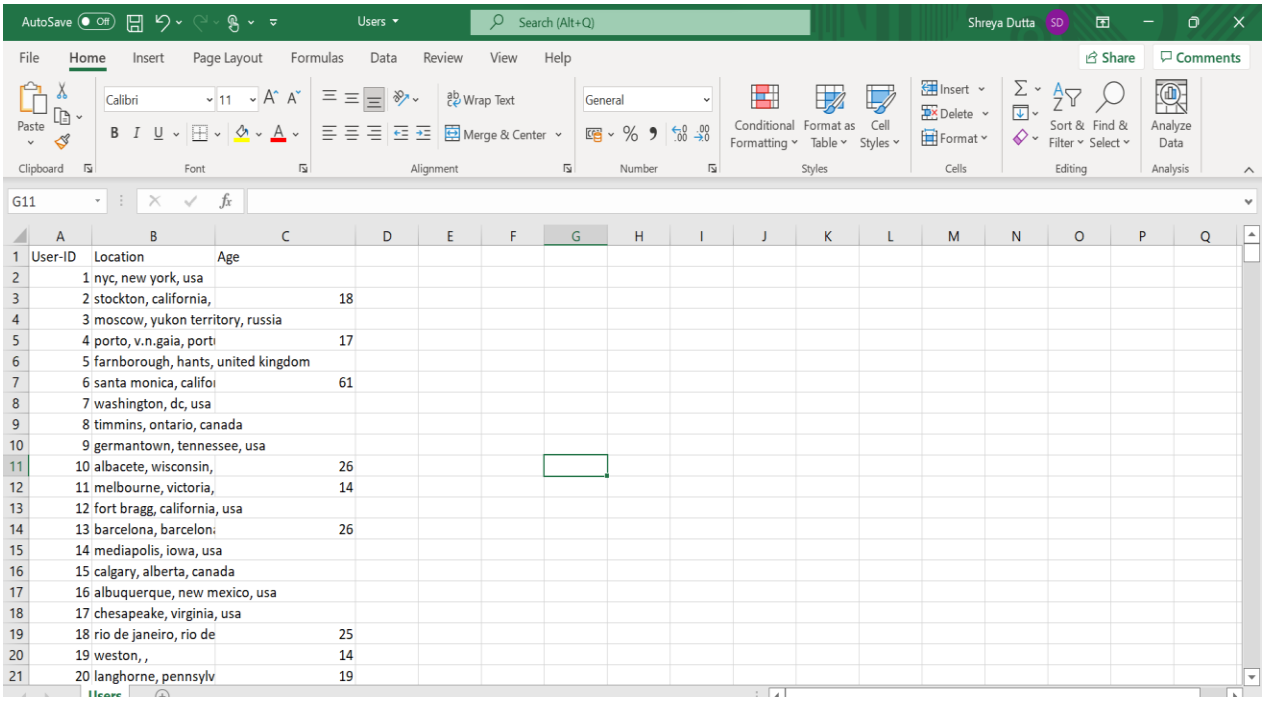
Out[3]:

	ISBN	Book-Title	Book-Author	Year-Of-Publication	Publisher	Image-URL-S	Image-URL-M
0	0195153448	Classical Mythology	Mark P. O. Morford	2002	Oxford University Press	http://images.amazon.com/images/P/0195153448.0...	http://images.amazon.com/images/P/0195153448.0...
1	0002005018	Clara Callan	Richard Bruce Wright	2001	HarperFlamingo Canada	http://images.amazon.com/images/P/0002005018.0...	http://images.amazon.com/images/P/0002005018.0...
2	0060973129	Decision in Normandy	Carlo D'Este	1991	HarperPerennial	http://images.amazon.com/images/P/0060973129.0...	http://images.amazon.com/images/P/0060973129.0...
3	0374157065	Flu: The Story of the Great Influenza Pandemic...	Gina Bari Kolata	1999	Farrar Straus Giroux	http://images.amazon.com/images/P/0374157065.0...	http://images.amazon.com/images/P/0374157065.0...
4	0393045218	The Mummies of Urumchi	E. J. W. Barber	1999	W. W. Norton & Company	http://images.amazon.com/images/P/0393045218.0...	http://images.amazon.com/images/P/0393045218.0...

The “Users.csv” data set contains User-ID, Location, Age columns. The User-ID and Age columns have the data type integer, while Location column has a data type of string.

Below is the “Users.csv” file:

The Age column of this data set has some missing or NaN values as seen below which were removed during the process of Data Cleaning.



```
In [5]: users.head()
```

Out[5]:

	User-ID	Location	Age
0	1	nyc, new york, usa	NaN
1	2	stockton, california, usa	18.0
2	3	moscow, yukon territory, russia	NaN
3	4	porto, v.n.gaia, portugal	17.0
4	5	farnborough, hants, united kingdom	NaN

The “Ratings.csv” data set has three columns which are User-ID, ISBN, and Book Rating. All three columns have an integer data type. Below is the “Ratings.csv” file:

```
In [4]: ratings.head()
```

Out[4]:

	User-ID	ISBN	Book-Rating
0	276725	034545104X	0
1	276726	0155061224	5
2	276727	0446520802	0
3	276729	052165615X	3
4	276729	0521795028	6

All these three data sets were used to create one combined data set that was used for the project. The combined data set is “popular_df” and it contains five columns.

It was created by merging ratings data set and books data set on ISBN.

The five columns are:

Book-Title, Book-Author, Image-URL-M, num_ratings, avg_ratings.

```
In [49]: popular_df
```

Out[49]:

	Book-Title	Book-Author	Image-URL-M	num_ratings	avg_ratings
0	Harry Potter and the Prisoner of Azkaban (Book 3)	J. K. Rowling	http://images.amazon.com/images/P/0439136350.0...	428	5.852804
3	Harry Potter and the Goblet of Fire (Book 4)	J. K. Rowling	http://images.amazon.com/images/P/0439139597.0...	387	5.824289
5	Harry Potter and the Sorcerer's Stone (Book 1)	J. K. Rowling	http://images.amazon.com/images/P/0590353403.0...	278	5.737410
9	Harry Potter and the Order of the Phoenix (Boo...	J. K. Rowling	http://images.amazon.com/images/P/043935806X.0...	347	5.501441
13	Harry Potter and the Chamber of Secrets (Book 2)	J. K. Rowling	http://images.amazon.com/images/P/0439064872.0...	556	5.183453
16	The Hobbit : The Enchanting Prelude to The Lor...	J.R.R. TOLKIEN	http://images.amazon.com/images/P/0345339681.0...	281	5.007117
17	The Fellowship of the Ring (The Lord of the Ri...	J.R.R. TOLKIEN	http://images.amazon.com/images/P/0345339703.0...	368	4.948370
26	Harry Potter and the Sorcerer's Stone (Harry P...	J. K. Rowling	http://images.amazon.com/images/P/059035342X.0...	575	4.895652
28	The Two Towers (The Lord of the Rings, Part 2)	J.R.R. TOLKIEN	http://images.amazon.com/images/P/0345339711.0...	260	4.880769
39	To Kill a Mockingbird	Harper Lee	http://images.amazon.com/images/P/0446310786.0...	510	4.700000
47	The Da Vinci Code	Dan Brown	http://images.amazon.com/images/P/0385504209.0...	898	4.642539
53	The Five People You Meet in Heaven	Mitch Albom	http://images.amazon.com/images/P/0786868716.0...	430	4.551163
55	The Catcher in the Rye	J.D. Salinger	http://images.amazon.com/images/P/0316769487.0...	449	4.545657
62	The Lovely Bones: A Novel	Alice Sebold	http://images.amazon.com/images/P/0316666343.0...	1295	4.468726

This was the final data set which was used to build the model for the Book Recommendation system. Out of a total of 12000 books, we chose 500 books and the model was built on these 500 books' data set.

The above picture shows only top 50 entries of the final data set "popular_df".

5. METHOD/ALGORITHM/MODEL USED

Now-a-days, online ratings, and reviews play an important role in book sales. Readers buy books depending on choices made by other customers. Our Recommendation system focuses on these reviews and ratings by others and filters books according to the user's preferences.

Here, we have employed the concept of **Collaborative Filtering**. Books are recommended by the **clustering model**. The model was trained and built by using various features such as user's ratings, book description, book titles, the number of views a book has received etc.

The system groups users into clusters so that each data point within the cluster is similar and dissimilar to the data point in the other cluster.

For example, let's say we have a dataset consisting of 50 random books and if a customer wants to get recommendations on book A, our model will find the distance from said book to all the other books in the data set. It will then fetch the five least distances and will hence provide those books as recommendations to the user based on the reviews, genre and number of reads (that is more than 200 reads).

In Collaborative Filtering, we tend to find similar users and recommend what similar users like. In this type of recommendation system, we don't use the features of the item to recommend it, rather we classify the users into the clusters of similar types, and recommend each user according to the preference of its cluster. Collaborative methods are typically worked out using a utility matrix. The task of the recommender model is to learn a function that predicts the utility of fit or similarity to each user. The utility matrix is typically very sparse, huge and has removed values.

The collaborative filtering algorithm used in our model is demonstrated below:

Collaborative Filtering Based Recommendation System

```
In [20]: x = ratings_with_name.groupby('User-ID').count()['Book-Rating'] > 200
         padhelikheusers = x[x].index

In [21]: filtered_rating = ratings_with_name[ratings_with_name['User-ID'].isin(padhelikheusers)]

In [22]: y = filtered_rating.groupby('Book-Title').count()['Book-Rating']>=50
         famous_books = y[y].index

In [23]: final_ratings = filtered_rating[filtered_rating['Book-Title'].isin(famous_books)]

In [24]: pt = final_ratings.pivot_table(index='Book-Title',columns='User-ID',values='Book-Rating')

In [25]: pt.fillna(0,inplace=True)

In [26]: pt.head(100)
```

This part groups the books according to User-ID and ratings. The books having more than 200 reads, meaning, at least 200 people have read the book, are considered for recommendations. The second criterion is the number of ratings which should be at least 50 for a book to be considered as recommendation.

Giving or recommending appropriate content based on the quality of experience is the most important and challenging issue in recommender systems. As collaborative filtering (CF) is one of the most prominent and popular techniques used for recommender systems, we propose a new clustering-based CF (CBCF) method using an incentivized/penalized user (IPU) model only with the ratings given by users, which is thus easy to implement. We aim to design such a simple clustering-based approach with no further prior information while improving the recommendation accuracy. To be precise, the purpose of CBCF with the IPU model is to improve recommendation performance such as precision, recall, and F1 score by carefully exploiting different preferences among users. Specifically, we formulate a constrained optimization problem in which we aim to maximize the recall (or equivalently F1 score) for a given precision. To this end, users are divided into several clusters based on the actual rating data and Pearson correlation coefficient.

Afterward, we give each item an incentive/penalty according to the preference tendency by users within the same cluster. Our experimental results show a significant performance improvement over the baseline CF scheme without clustering in terms of recall or F1 score for a given precision.

The part of the algorithm which defines the clustering method and calculating similarities methodology are shown below.

```
In [27]: from sklearn.metrics.pairwise import cosine_similarity

In [28]: similarity_scores = cosine_similarity(pt)

In [29]: similarity_scores.shape

Out[29]: (706, 706)

In [45]: def recommend(book_name):
             index = np.where(pt.index==book_name)[0][0]
             similar_items = sorted(list(enumerate(similarity_scores[index])),key=lambda x:x[1],reverse=True)[1:6]

             data=[]
             for i in similar_items:
                 item=[]
                 temp_df = books[books['Book-Title'] == pt.index[i[0]]]
                 item.extend(list(temp_df.drop_duplicates('Book-Title')['Book-Title'].values))
                 item.extend(list(temp_df.drop_duplicates('Book-Title')['Book-Author'].values))
                 item.extend(list(temp_df.drop_duplicates('Book-Title')['Image-URL-M'].values))

                 data.append(item)
             return data
```

Using cosine similarities, we found the distances of each book from every other book in the data set. The recommendation function written above finds the five best books based on the user's input and gives those five books as recommendations.

6. RESULTS AND DISCUSSION

The methodology used to build the project model was as follows:

- Exploratory data analysis (EDA) – Visualizing the data
- Data Processing – Data cleaning
- Model Building
- Providing Recommendations
- Testing and Validating

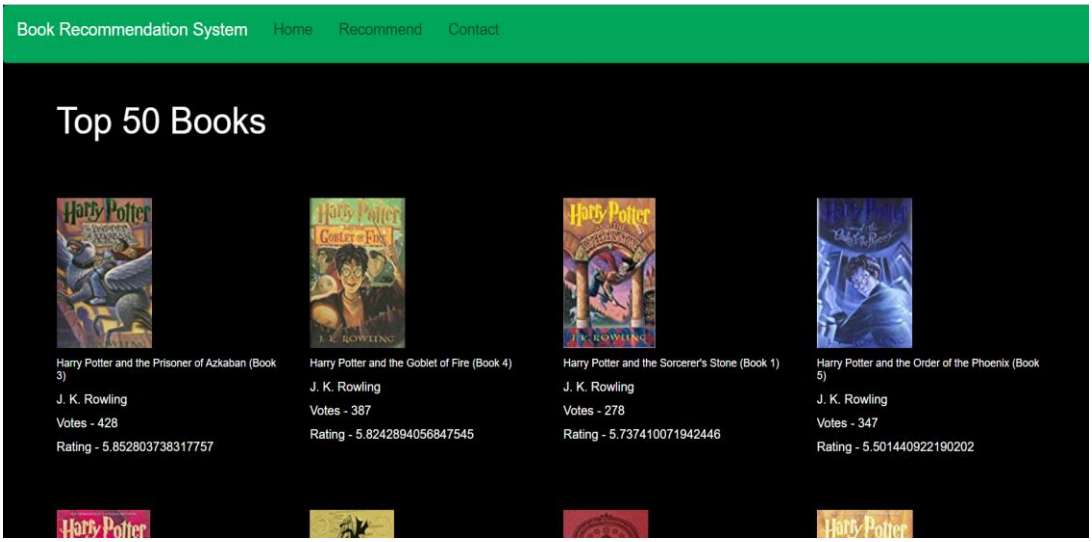
The results including providing the users with the best recommendations of books based on his or her input. The project model generated the following results.

The image below shows the five recommendations for the book ‘1994’ generated by the project model which is the book recommendation system using Collaborative filtering, clustering and cosine similarities.

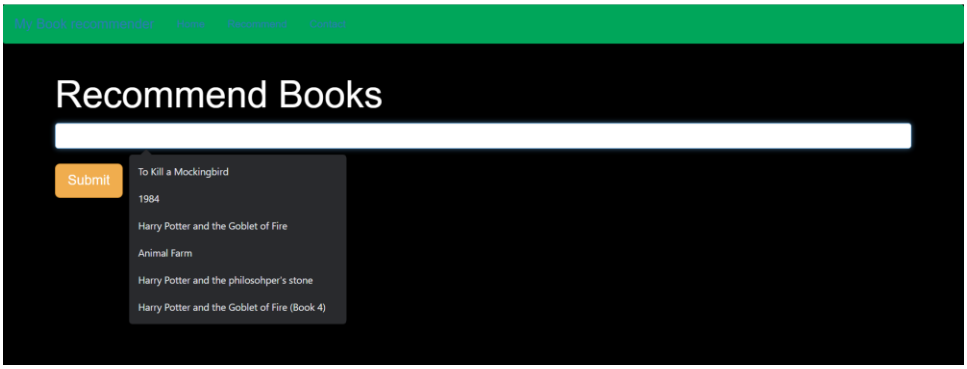
```
In [47]: recommend('1984')

Out[47]: [['Animal Farm',
           'George Orwell',
           'http://images.amazon.com/images/P/0451526341.01.MZZZZZZZ.jpg'],
          ["The Handmaid's Tale",
           'Margaret Atwood',
           'http://images.amazon.com/images/P/0449212602.01.MZZZZZZZ.jpg'],
          ['Brave New World',
           'Aldous Huxley',
           'http://images.amazon.com/images/P/0060809833.01.MZZZZZZZ.jpg'],
          ['The Vampire Lestat (Vampire Chronicles, Book II)',
           'ANNE RICE',
           'http://images.amazon.com/images/P/0345313860.01.MZZZZZZZ.jpg'],
          ['The Hours : A Novel',
           'Michael Cunningham',
           'http://images.amazon.com/images/P/0312243022.01.MZZZZZZZ.jpg']]
```

The web application of the project is as follows:

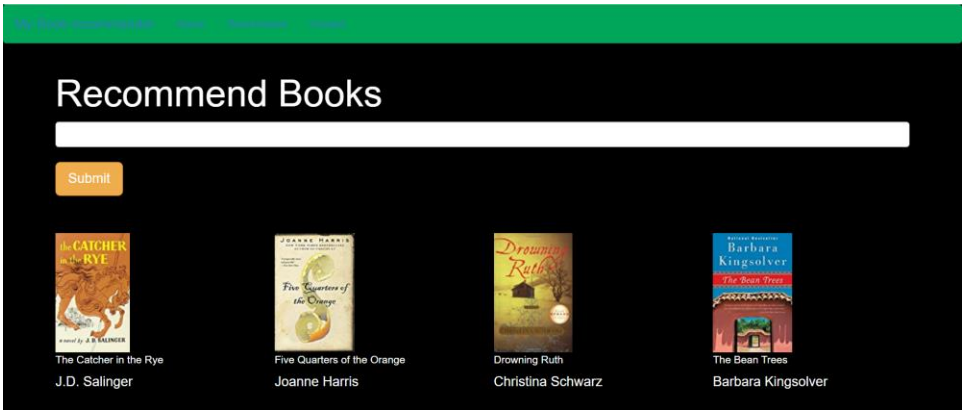
The HOME page of the website displays the TOP 50 popular books. It contains a navigation bar with Recommend and Contact tabs as well.



On the Recommend tab, the user can provide his or her input of the book and get recommendations for the same. Five recommendations are provided for the user.



These are the recommendations for the book “To Kill a Mockingbird”.



7. CONCLUSION AND FUTURE ENHANCEMENT

In this project, we recommended the books for a user using a collaborative filtering and clustering based model which is an unsupervised machine learning algorithm. We used the datasets downloaded from Kaggle.com. We implemented the functionalities in the system according to the requirements after understanding all the modules of the system.

This project was able to present a comprehensive review on Book Recommender systems and improving the recommender systems. From the results and visualizations, we can deduce that the accuracy of rating followed a normal distribution which suggests consistency and efficiency. We were able to train efficient models that had high accuracy.

The System has adequate scope for improvement in the future. We can develop and launch a Mobile app. Also, System security, data security and reliability could be the major features which can be done in future.

Over many years significant work has been done in academics and industry to develop new approaches to recommender systems, but still interest remains high because it helps user to handle surplus information in order to provide personalized recommendations and services to them.

Along with the recommendation we can find many other important challenges in the field of book recommendation system, like payment of books through online, customer order tracking, confirmation of order and the replacement or cancellations of order. These features can be incorporate for better recommendation in the future work of book recommendation. This Book Recommendation System will prove to be helpful for lots of people as well as students who need the best books available from the database for both general and academic purpose.

In this project, we reviewed various limitations of the current recommendation methods. We further propose to develop an algorithm that solves the limitations faced by above developed recommender systems hoping that the issues presented in this paper would advance the discussion in the recommender systems community about the next generation of recommendation technologies. In future, customer profiles can also be included for better and more personalized recommendations.

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