Introduction:
Book recommendation System.

In today's digital age, with an abundance of books available in various genres and formats, it can be overwhelming for readers, especially students, to navigate through the vast sea of options and find books that align with their interests and preferences. This is where a book recommendation system comes in handy.

A book recommendation system is a powerful tool that leverages data analysis, machine learning, and artificial intelligence techniques to analyse and understand readers' preferences, behaviours, and reading patterns. It then provides personalised book recommendations that match their individual tastes, helping them discover new books they might not have come across otherwise.

Problem Statement:
We are building a model based collaborative filtering and a content based recommendation systems that have been trained on a huge dataset consisting of books and ratings. So the model will recommend books to the users based upon preferences. The recommendation also depends upon the type of the recommendation model used. We are also building a hybrid model which is a combination of model based and content based recommendation systems.

Data Set Description:

We have used a books dataset from kaggle which has around 7 csv files.Out of the 7 files,we have primarily used book.csv and ratings.csv files.The books.csv files consists of about 999 book titles along with their respective authors and many other columns such as book_id,worktext_review,work reviews etc.
The ratings.csv file consists of ratings given by 56713 users for the books.
It consists of the attribute columns book_id,user_id and their corresponding ratings.

1.EDA

(a)Loading the dataset and viewing the first 5 rows of the books csv file after retaining only the necessary column
attributes

1.Perform EDA on the data.

```
[ ]
    # Load the books dataset
    books = pd.read_csv('/content/FinalData.csv',encoding='latin-1')

    # Load the ratings dataset
    ratings = pd.read_csv('/content/ratings.csv')
```

```
books.head()
```

	book_id	authors	title	genre
0	1	Suzanne Collins	The Hunger Games (The Hunger Games, #1)	SciFi;Drama
1	2	J.K. Rowling, Mary GrandPré	Harry Potter and the Sorcerer's Stone (Harry P...	Fantasy;Young-Age
2	3	Stephenie Meyer	Twilight (Twilight, #1)	Fantasy
3	4	Harper Lee	To Kill a Mockingbird	Self-Help;Drama
4	5	F. Scott Fitzgerald	The Great Gatsby	Drama

(b) Viewing the first 5 rows of ratings.csv file

```
ratings.head()
```

	user_id	book_id	rating
0	1	258	5
1	2	260	5
2	2	26	4
3	2	315	3
4	2	33	4

©.Merging the two datasets on the book id column and viewing the first few rows o the result

```
# Merge the two datasets on the book_id column
df = pd.merge(ratings, books, on='book_id')

# Print the first five rows of the dataset
df.head(10)
```

	user_id	book_id	rating	authors	title	genre
0	1	258	5	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy
1	11	258	3	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy
2	143	258	4	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy
3	242	258	5	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy
4	325	258	4	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy
5	362	258	2	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy
6	389	258	2	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy
7	396	258	3	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy
8	403	258	3	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy
9	473	258	4	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy

(d)Making bar chart to visualise the number of ratings for each value in string

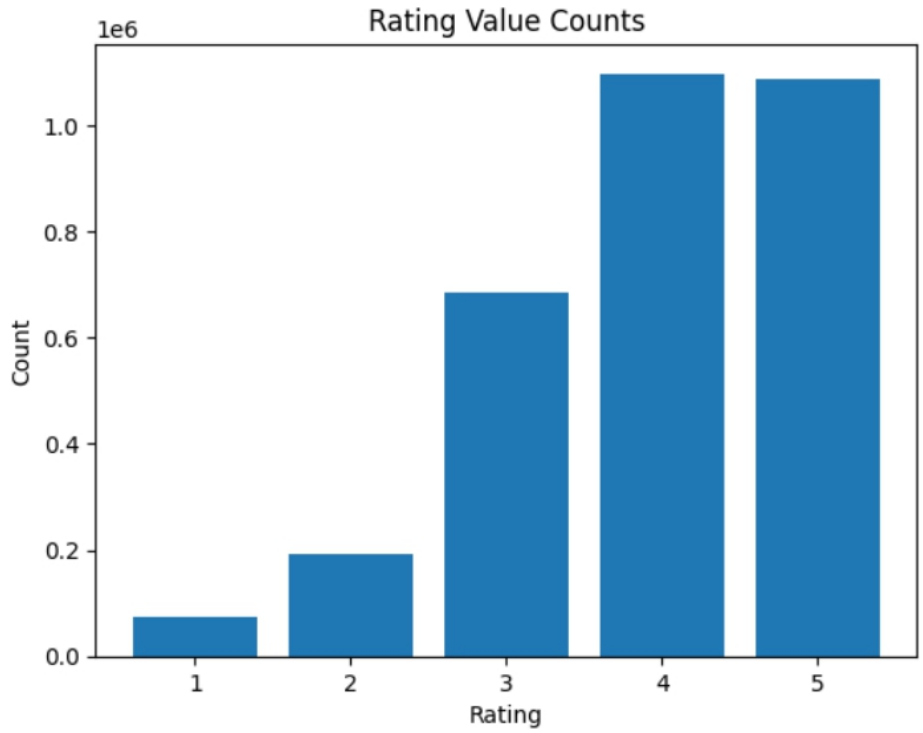
```
#Visualisation of number of ratings for each value in rating

value_counts = df['rating'].value_counts()

# Create a bar chart
plt.bar(value_counts.index, value_counts.values)

# Set chart title and labels
plt.title('Rating Value Counts')
plt.xlabel('Rating')
plt.ylabel('Count')

# Show the chart
plt.show()
```



2.DATA PREPROCESSING:

We need to preprocess the data before we can use it to build our recommendation models.This involves removing any irrelevant columns, handling missing values, and converting categorical variables into numerical values.

(a)General preprocessing

```
[ ] #Checking for null values
    df.isna().sum()
```

```
user_id    0
book_id    0
rating     0
authors    0
title      0
genre      0
dtype: int64
```

```
#Checking for duplicates
df.duplicated().sum()
```

```
0
```

```
[ ] #list of distinct users
    list_of_distinct_users = list(df['user_id'].unique())
    len(list_of_distinct_users)
```

```
53417
```

```
[ ] #list of distinct books
    list_of_distinct_books = list(df['book_id'].unique())
    len(list_of_distinct_books)
```

```
999
```

```
[ ] #number of ratings given by every user
    rating_users = df['user_id'].value_counts().reset_index().\
                   rename({'index':'user_id','user_id':'Ratings'},axis=1)
```

```
rating_users['Ratings']
```

```
0        173
1        172
2        172
3        171
4        167
        ...
53412      1
53413      1
53414      1
53415      1
53416      1
Name: Ratings, Length: 53417, dtype: int64
```

(b)Counting the number of ratings for each book

```
[ ] #number of ratings given for every book
    rating_book = df['book_id'].value_counts().reset_index().\
                  rename({'index':'book_id','book_id':'Ratings'},axis=1)
```

```
rating_book['Ratings'].unique()
```

```
array([22806, 21850, 19088, 16931, 16604, 16549, 15953, 15855, 15657,
       15558, 15523, 15304, 15258, 15081, 14693, 14472, 14382, 14328,
       13556, 13451, 13445, 13089, 13072, 12727, 12698, 12530, 12105,
       12101, 11921, 11780, 11677, 11578, 11304, 11264, 10949, 10692,
       10649, 10394, 10361, 10312, 10308, 10175,  9977,  9960,  9712,
        9620,  9612,  9584,  9433,  9391,  9323,  9090,  9035,  8916,
        8849,  8383,  8297,  8263,  8192,  8179,  8109,  7885,  7727,
        7724,  7714,  7667,  7662,  7626,  7606,  7563,  7543,  7458,
        7214,  7192,  7110,  7040,  7002,  6944,  6899,  6861,  6854,
        6848,  6779,  6717,  6702,  6615,  6601,  6598,  6592,  6536,
        6504,  6478,  6466,  6421,  6406,  6401,  6343,  6331,  6313,
        6307,  6305,  6301,  6300,  6273,  6237,  6229,  6212,  6190,
        6135,  6102,  6082,  6039,  6034,  5990,  5973,  5897,  5864,
        5847,  5844,  5764,  5705,  5681,  5672,  5615,  5602,  5554,
        5531,  5495,  5492,  5489,  5467,  5408,  5358,  5346,  5326,
        5316,  5306,  5302,  5297,  5275,  5274,  5257,  5249,  5199,
        5178,  5171,  5154,  5086,  5076,  5073,  5052,  5014,  5006,
        4921,  4904,  4898,  4868,  4853,  4841,  4810,  4759,  4753,
        4750,  4723,  4722,  4682,  4679,  4658,  4610,  4606,  4577,
        4576,  4467,  4463,  4460,  4459,  4452,  4451,  4415,  4409,
        4405,  4377,  4295,  4274,  4260,  4247,  4239,  4229,  4227,
        4220,  4213,  4199,  4185,  4180,  4161,  4118,  4080,  4067,
        4056,  4041,  4034,  4021,  4017,  4015,  4011,  4003,  4000,
        3998,  3995,  3959,  3950,  3948,  3917,  3916,  3889,  3881,
```

RECOMMENDATION SYSTEMS

1.Model based collaborative filtering system(KNN)

(a)Creating a new dataframe with userId,bookID and the ratings

```
#Create a new dataframe with userId,bookID and ratings
knn_data = df[['user_id','book_id','rating']]
knn_data.head()
```

1 to 5 of 5 entries Filter

index	user_id	book_id	rating
0	1	258	5
1	11	258	3
2	143	258	4
3	242	258	5
4	325	258	4

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(b)Splitting the dataset into training and testing data and training the KNN model on the training dataset.Feature and Target arrays were also created for the train and test datasets.

```
[ ] # Split the data into train and test sets
    train_data, test_data = train_test_split(knn_data, test_size=0.2, random_state=42)
```

```
[ ] # Define the feature and target columns
    feature_cols = ['user_id', 'book_id']
    target_col = 'rating'
```

```
[ ] # Create the feature and target arrays for train and test sets
    X_train = train_data[feature_cols].values
    y_train = train_data[target_col].values
    X_test = test_data[feature_cols].values
    y_test = test_data[target_col].values
```

```
# Train a kNN model on the train set
k = 5  # number of neighbors
model = KNeighborsRegressor(n_neighbors=k)
model.fit(X_train, y_train)
```

(c) Using the trained KNN model to recommend on the test data set.

Calculating accuracy metrics such MAE and RMSE to test the accuracy of the model

```
[ ]  # Use the trained model to predict on the test set
     y_pred = model.predict(X_test)
```

Double-click (or enter) to edit

```
# Calculate the MAE and RMSE on the test set
mae = mean_absolute_error(y_test, y_pred)
rmse = np.sqrt(mean_squared_error(y_test, y_pred))

# Print the metric
print("Model Performance :")
print('MAE:', mae)
print('RMSE:', rmse)
```

```
Model Performance :
MAE: 0.8596672458828577
RMSE: 1.07753202633971
```

As you can see,the MAE value is 0.85966 and the RMSE value is 1.0775 which proves that the model performance is accurate.

2.Content based recommendation system.

(a) First we are creating a binary column for each of the unique genres(Fiction,poetry,crime,biography,etc)

```
#creating new binary columns for each unique genre
genres = set()
genre_dict = {}
for genre_list in df['genre']:
    genres.update(genre_list.split(';'))

for genre in genres:
    df[genre] = df['genre'].apply(lambda x: int(genre in x))


df.head()
```

	user_id	book_id	rating	authors	title	genre	Self-Help	Fiction	Poetry	...	Crime	Kids	Biography	Domestic	Academic	Classic	Romance	SciFi	Young-Age	Horror
0	1	258	5	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy	1	0	0	0	...	0	0	0	0	0	0	0	0	0	0
1	11	258	3	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy	1	0	0	0	...	0	0	0	0	0	0	0	0	0	0
2	143	258	4	Carlos Ruiz Zafón, Lucia Graves	The Shadow of the Wind (The Cemetery of Forgot...	Thriller;Fantasy	1	0	0	0	...	0	0	0	0	0	0	0	0	0	0
				Carlos Ruiz	The Shadow of																

(b)Creating a pivot matrix using the different genres.

```
## First lets create a Pivot matrix

book_features_df=df.pivot_table(index='title',columns=None ,values=['Domestic', 'Drama', 'Young-Age', 'Fantasy', 'Fiction', 'Biography', 'Poetry', 'Self-Help', 'Kids', 'Thriller', 'Sc
book_features_df.head()
```

1 to 5 of 5 entries Filter

title	Academic	Biography	Classic	Comedy	Crime	Domestic	Drama	Erotic	Fantasy	Fiction	History	Horror	Kids	Poetry	Psychological	Romance	SciFi	Self-Help	Thriller	You
11/22/63	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
1776	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
1Q84	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	
1st to Die (Women's Murder Club, #1)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	

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(c)Building the content based recommendation system by calculating jaccard's coefficient between the user's preferences and the book's features in the training data after converting them to vectors.After Jaccard's coefficient is calculated,5 closest vectors which are books most similar to the user's preferences are recommended.Their corresponding distances are also displayed.

```
from scipy.spatial.distance import pdist,squareform,cdist

book_features_df_matrix = (book_features_df.values)
idx = np.random.choice(book_features_df.shape[0])
print('index of the book :{0}'.format(idx))
# Get the vector to compare
vector_to_compare = book_features_df_matrix[idx]

# Calculate the Jaccard distance between the selected vector and all others
jaccard_dist = cdist([vector_to_compare], book_features_df_matrix, metric='jaccard')[0]

# Find the indices of the 5 closest vectors
closest_indices = np.argsort(jaccard_dist)[1:6]
# Print the closest vectors and their distances
print("Best recommendations for the book ",book_features_df.index[idx], "are:")
for idx in range(0,len(closest_indices)):
    print('{0} : {1}'.format(idx+1,book_features_df.index[closest_indices[idx]]))
```

```
index of the book :686
Best recommendations for the book  The Giving Tree are:
1 : Curious George
2 : Dr. Seuss's Green Eggs and Ham: For Soprano, Boy Soprano, and Orchestra
3 : Where the Red Fern Grows
4 : Bridge to Terabithia
5 : The Undomestic Goddess
```

3)Hybrid recommendation model-(Combination of Content based and model based collaborative filtering)

(a)Loading the required csv files and reducing the number of records in the dataset for easier computation.
The average rating for each of the books is also calculated.

```
[ ] from sklearn.metrics.pairwise import cosine_similarity
    from sklearn.feature_extraction.text import CountVectorizer

    # Load the ratings dataset
    books_df= pd.read_csv('/content/FinalData.csv',encoding='latin-1')

    # Load the movies dataset
    ratings_df = pd.read_csv('/content/ratings.csv')
```

```
[ ] #Reduce the dataset for faster computation
    movies_df=books_df.query('book_id < 500')
    ratings_df=ratings_df.query('book_id < 500')
```

```
[ ] #calculate average rating for each book
    ratings_mean_df = ratings_df.groupby(['book_id'], as_index=False, sort=False).mean().rename(columns={'rating':'rating_mean'})[['book_id','rating_mean']]
    ratings_mean_df.head()
```

1 to 5 of 5 entries Filter

index	book_id	rating_mean
0	258	4.105919003115265
1	260	3.8947368421052633
2	26	3.6209455324357407
3	315	3.3997809419496168
4	33	4.001326963906582

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(b)Both the books.csv and ratings.csv files are merged on book_id

```
[ ] #Merging both the datasets
    books_df = pd.merge(books_df,ratings_mean_df,on=['book_id'])
```

```
books_df.head()
```

1 to 5 of 5 entries Filter

index	book_id	authors	title	genre	rating_mean
0	1	Suzanne Collins	The Hunger Games (The Hunger Games, #1)	SciFi;Drama	4.2797070946242215
1	2	J.K. Rowling, Mary GrandPré	Harry Potter and the Sorcerer's Stone (Harry Potter, #1)	Fantasy;Young-Age	4.351350114416476
2	3	Stephenie Meyer	Twilight (Twilight, #1)	Fantasy	3.214340558738409
3	4	Harper Lee	To Kill a Mockingbird	Self-Help;Drama	4.3293692372171
4	5	F. Scott Fitzgerald	The Great Gatsby	Drama	3.7722235605878103

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(c)Building a dataframe with information about the genres

```
#Build a dataframe with information about genres
books_df['genre'] = books_df['genre'].str.split(';')
books_with_genres_df = books_df.copy()
for index, row in books_df.iterrows():
    for genre in row['genre']:
        books_with_genres_df.at[index, genre] = 1
books_with_genres_df = books_with_genres_df.fillna(0)
books_with_genres_df.head()
```

```
Warning: Total number of columns (26) exceeds max_columns (20). Falling back to pandas display.
```

	book_id	authors	title	genre	rating_mean	SciFi	Drama	Fantasy	Young-Age	Self-Help	...	Fiction	Psychological	Domestic	Erotic	Poetry	Kids	Horror	Comedy	Academic	
0	1	Suzanne Collins	The Hunger Games (The Hunger Games, #1)	[SciFi, Drama]	4.279707	1.0	1.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	J.K. Rowling, Mary GrandPré	Harry Potter and the Sorcerer's Stone (Harry P...	[Fantasy, Young-Age]	4.351350	0.0	0.0	1.0	1.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	3	Stephenie Meyer	Twilight (Twilight, #1)	[Fantasy]	3.214341	0.0	0.0	1.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	Harper Lee	To Kill a Mockingbird	[Self-Help, Drama]	4.329369	0.0	1.0	0.0	0.0	1.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(d)Converting the various genres into vectors and calculating the similarities between books

Using cosine similarity

```
#build a vectors of vectors for genres
genres_df = books_with_genres_df.drop(columns=['book_id','title','genre','rating_mean','authors'])
genres_matrix = genres_df.to_numpy()
```

```
genres_similarity = cosine_similarity(genres_matrix)
ratings_matrix = ratings_df.pivot(index='book_id', columns='user_id', values='rating').fillna(0).to_numpy()
ratings_similarity = cosine_similarity(ratings_matrix)
hybrid_similarity = (genres_similarity + ratings_similarity) / 2
hybrid_similarity_df = pd.DataFrame(hybrid_similarity, columns=ratings_df['book_id'].unique(), index=ratings_df['book_id'].unique())
```

(e)Defining a method to make recommendations similar to the input book entered by the user.This is achieved after using cosine similarity to calculate the measure of similarities between the books

```
[ ] def get_book_recommendations(book_title, num_recommendations=5):
        book_id = books_df.loc[books_df['title'] == book_title]['book_id'].values[0]
        book_similarity = hybrid_similarity_df[book_id]
        similar_books = book_similarity.sort_values(ascending=False)[1:num_recommendations+1]
        recommended_books = books_df.loc[books_df['book_id'].isin(similar_books.index)]
        return recommended_books[['title', 'genre', 'rating_mean']]
```

```
book = input("Enter a book title :")
get_book_recommendations(book)
```

```
Enter a book title :Eat, Pray, Love
```

1 to 5 of 5 entries Filter

index	title	genre	rating_mean
22	Harry Potter and the Chamber of Secrets (Harry Potter, #2)	Fantasy,Young-Age	4.229418151625471
32	Memoirs of a Geisha	Biography	4.001326963906582
183	Matilda	Kids,Fantasy	4.222037422037422
221	The Bourne Identity (Jason Bourne, #1)	Thriller,Fiction	4.000323519896473
370	Stranger in a Strange Land	Fantasy	3.8706732597945988

Show 25 per page

As you can see, after user gave the input :'Eat,pray,love'
The recommendation model recommends 5 books similar to the input book given by the user