Book Recommender system

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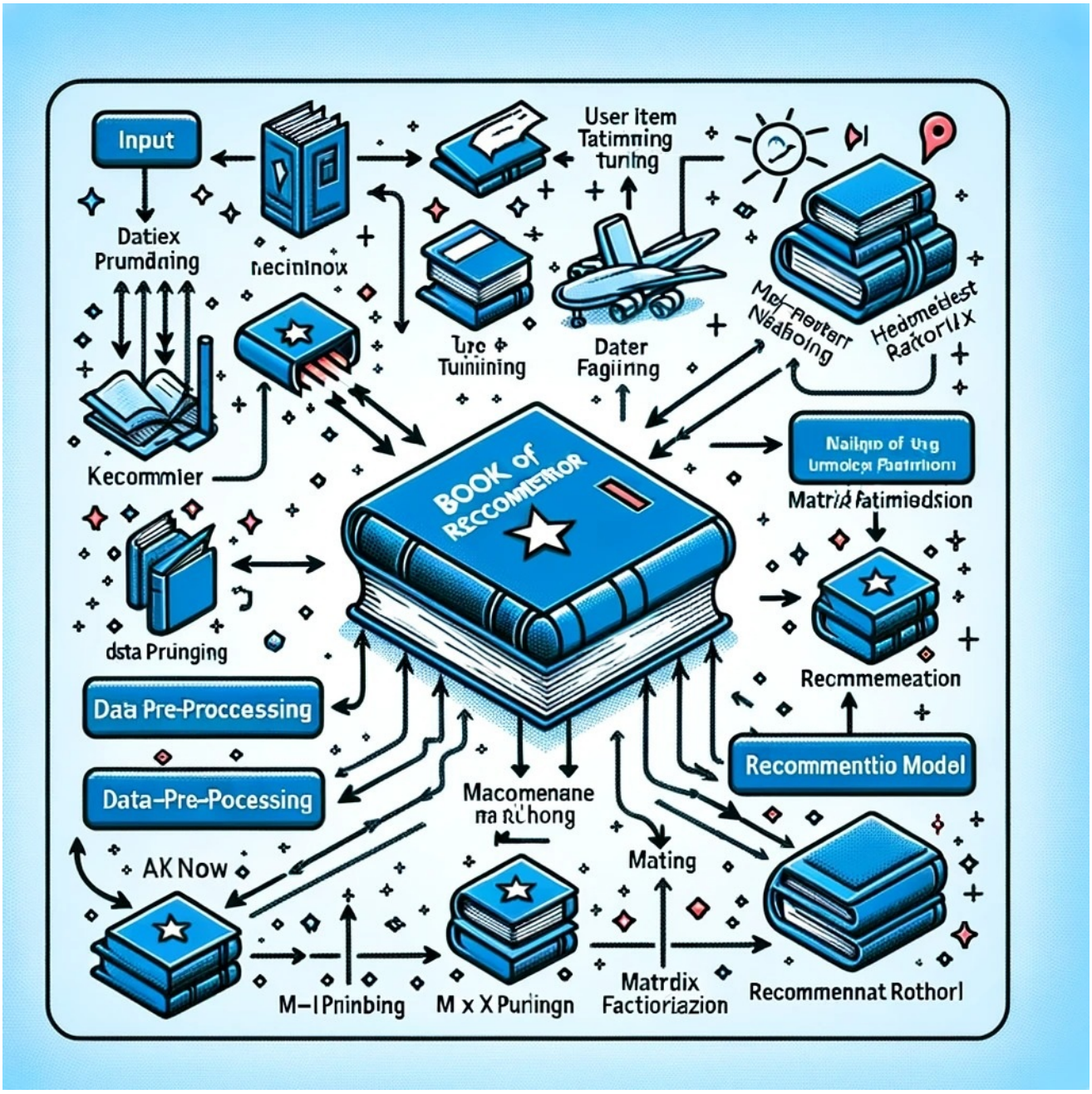


- # Step 1: Import necessary libraries

In [3]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from scipy.sparse import csr_matrix
from sklearn.neighbors import NearestNeighbors
```

- # Step 2: Load books data

In [4]:
```
books = pd.read_csv(r'C:\Users\Hamidreza\OneDrive\Desktop\web project\Book-DataSet/books.csv',
                    sep=";", on_bad_lines='skip', encoding='latin-1', low_memory=False)

books = books[['ISBN', 'Book-Title', 'Book-Author', 'Year-Of-Publication', 'Publisher']]

books.rename(columns={"Book-Title": "title", "Book-Author": "author", "Year-Of-Publication": "year", "Publisher
```

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

Out[5]:

	ISBN	title	author	year	publisher
0	0195153448	Classical Mythology	Mark P. O. Morford	2002	Oxford University Press
1	0002005018	Clara Callan	Richard Bruce Wright	2001	HarperFlamingo Canada
2	0060973129	Decision in Normandy	Carlo D'Este	1991	HarperPerennial
3	0374157065	Flu: The Story of the Great Influenza Pandemic...	Gina Bari Kolata	1999	Farrar Straus Giroux
4	0393045218	The Mummies of Urumchi	E. J. W. Barber	1999	W. W. Norton & Company

In [5]:
```
books.shape
```

Out[5]:
```
(271360, 5)
```

- # Step 3: Load users data

In [6]:
```
users = pd.read_csv(r'C:\Users\Hamidreza\OneDrive\Desktop\web project\Book-DataSet/users.csv',
                    sep=";", on_bad_lines='skip', encoding='latin-1', low_memory=False)
```

users.head()

- # Step 4: Load ratings data

In [7]:
```
ratings = pd.read_csv(r'C:\Users\Hamidreza\OneDrive\Desktop\web project\Book-DataSet/ratings.csv',
                      sep=";", on_bad_lines='skip', encoding='latin-1', low_memory=False)
ratings.rename(columns={"User-ID": "user_id", "Book-Rating": "rating"}, inplace=True)
```

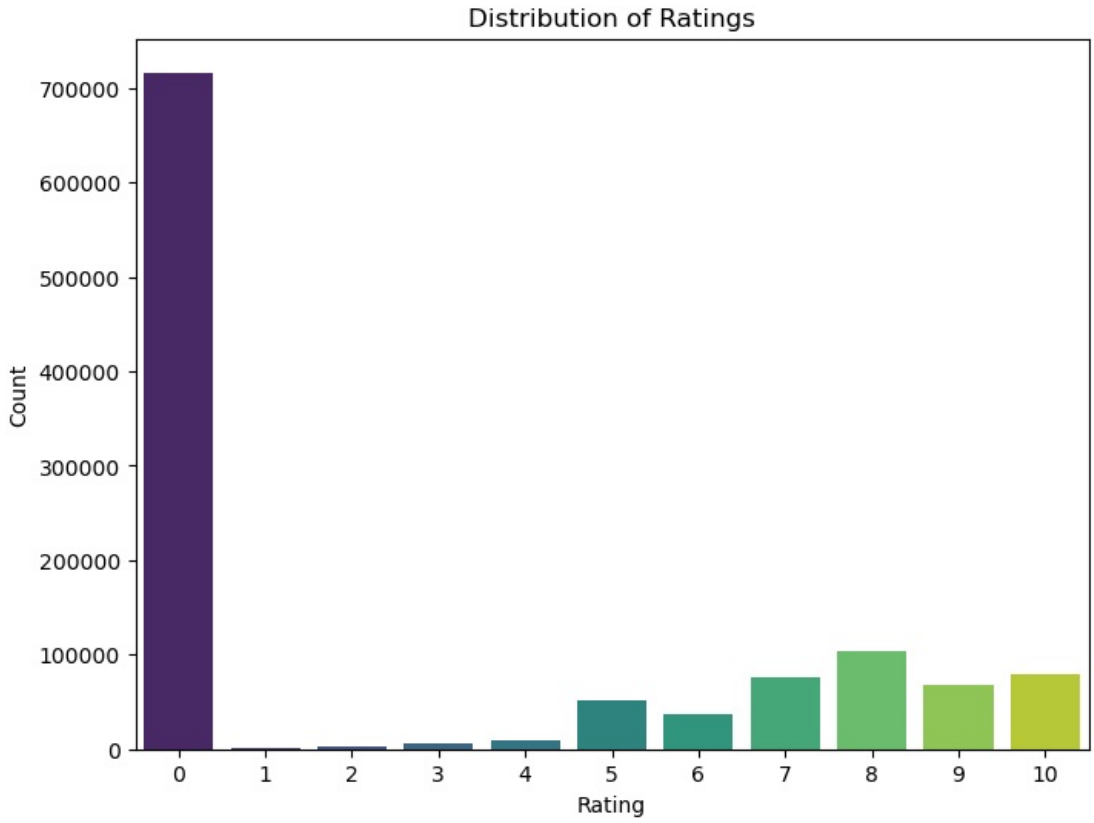
In [8]:
```
ratings.head()
```

Out[8]:

	user_id	ISBN	rating
0	276725	034545104X	0
1	276726	0155061224	5
2	276727	0446520802	0
3	276729	052165615X	3
4	276729	0521795028	6

- # Step 5: Data exploration and visualization

In [9]:
```
# Visualize the distribution of ratings
plt.figure(figsize=(8, 6))
sns.countplot(x='rating', data=ratings, palette='viridis')
plt.title('Distribution of Ratings')
plt.xlabel('Rating')
plt.ylabel('Count')
plt.show()
```



- # Step 6: Filtering users who rated more than 200 books

To ensure statistical significance, users with less than 200 ratings are excluded.

In [10]:
```
user_counts = ratings['user_id'].value_counts()
active_users = user_counts[user_counts > 200].index
ratings = ratings[ratings['user_id'].isin(active_users)]
```

In [11]:
```
ratings.head()
```

Out[11]:

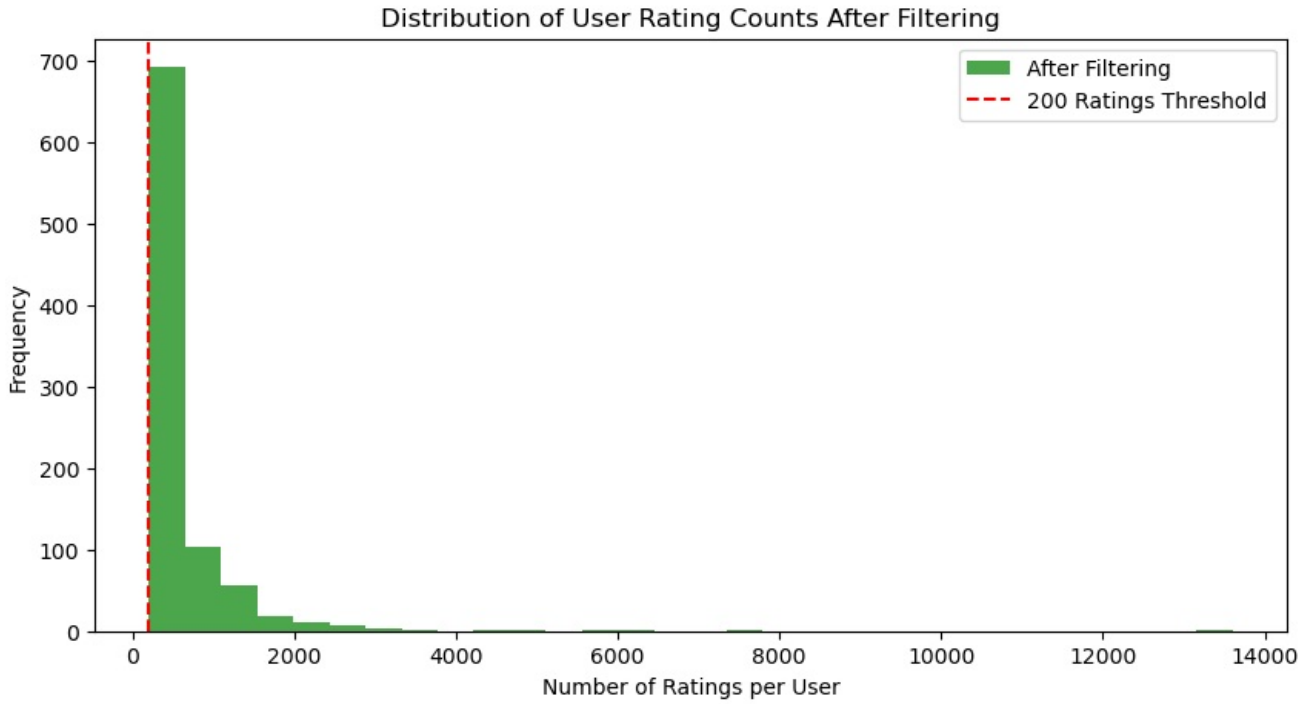
	user_id	ISBN	rating
1456	277427	002542730X	10
1457	277427	0026217457	0
1458	277427	003008685X	8
1459	277427	0030615321	0
1460	277427	0060002050	0

Visualization of user activity after filtering

In [22]:
```
import matplotlib.pyplot as plt

# Assuming 'ratings' is your initial DataFrame and 'active_users' is defined as per your description


plt.figure(figsize=(10, 5))
user_counts_after = ratings[ratings['user_id'].isin(active_users)]['user_id'].value_counts()
plt.hist(user_counts_after, bins=30, alpha=0.7, color='green', label='After Filtering')
plt.xlabel('Number of Ratings per User')
plt.ylabel('Frequency')
plt.title('Distribution of User Rating Counts After Filtering')
plt.axvline(x=200, color='r', linestyle='--', label='200 Ratings Threshold')
plt.legend()
plt.show()
```



- # Step 7: Preparing data for modeling

to only include books that have received 50 or more ratings.

It ensures that the dataset focuses on books with a significant number of ratings, which might be more relevant for building a reliable recommender system.

In [12]:
```
ratings_with_books = ratings.merge(books, on="ISBN")
num_ratings = ratings_with_books.groupby('title')['rating'].count().reset_index()
num_ratings.rename(columns={"rating": "number_of_rating"}, inplace=True)                    #This line rena
final_ratings = ratings_with_books.merge(num_ratings, on='title')
final_ratings = final_ratings[final_ratings['number_of_rating'] >= 50]                     # to include on
final_ratings.drop_duplicates(['user_id', 'title'], inplace=True)                          #This line rena
book_pivot = final_ratings.pivot_table(columns='user_id', index='title', values='rating')
```

In [13]:
```
book_pivot
```

Out[13]:

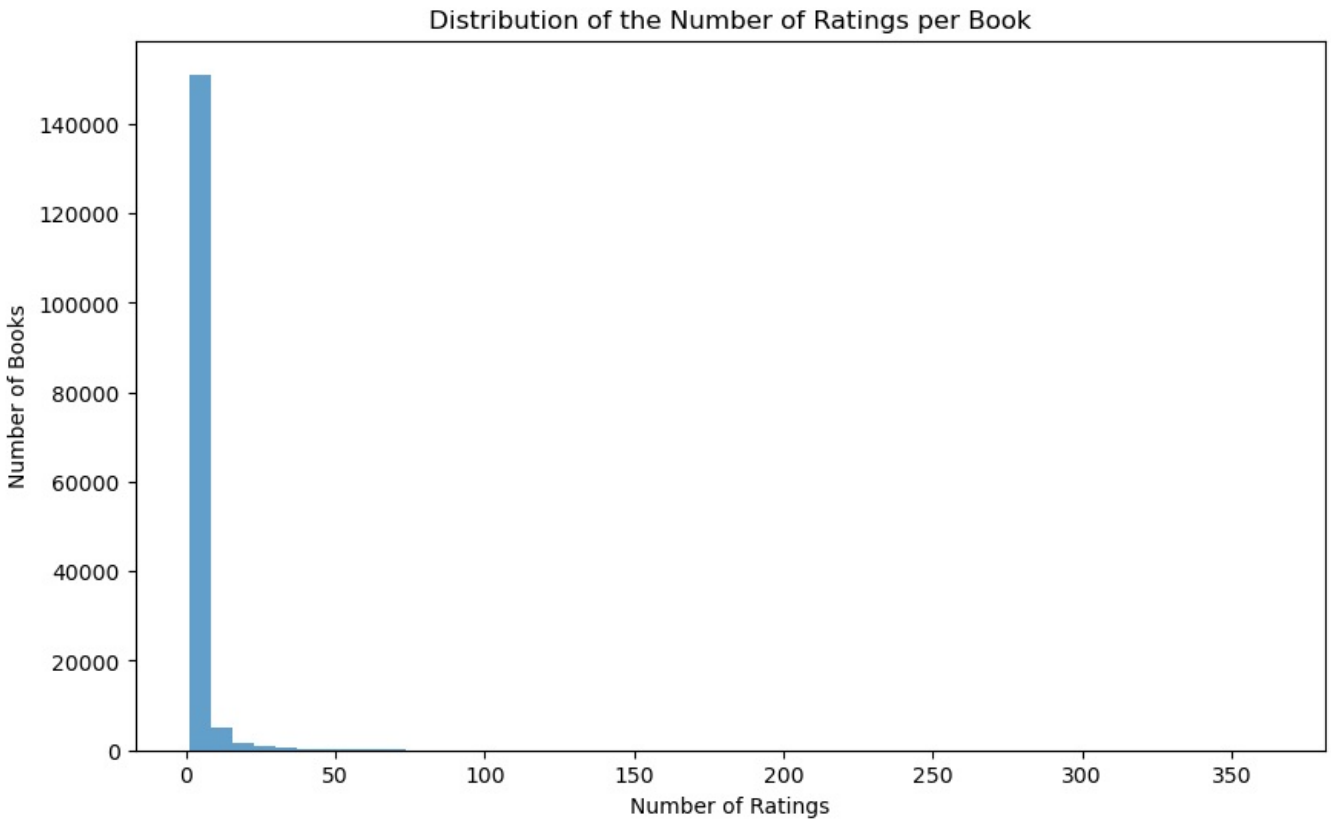
user_id	254	2276	2766	2977	3363	3757	4017	4385	6242	6251	...	274004	274061	274301	274308	274808	275970	277427	27
title																			
1984	9.0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	0.0	NaN	
1st to Die: A Novel	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
2nd Chance	NaN	10.0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	0.0	NaN	NaN	NaN	
4 Blondes	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0.0	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
84 Charing Cross Road	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	10.0	NaN	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Year of Wonders	NaN	NaN	NaN	7.0	NaN	NaN	NaN	NaN	7.0	NaN	...	NaN	NaN	NaN	NaN	NaN	0.0	NaN	
You Belong To Me	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
Zen and the Art of Motorcycle Maintenance: An Inquiry into Values	NaN	NaN	NaN	NaN	0.0	NaN	NaN	NaN	NaN	0.0	...	NaN	NaN	NaN	NaN	NaN	0.0	NaN	
Zoya	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
\O\" Is for Outlaw"	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	8.0	NaN	NaN	NaN	NaN	

742 rows × 888 columns

In [33]:
```
import matplotlib.pyplot as plt

# Assuming num_ratings is already defined as in your code
```

```
plt.figure(figsize=(10, 6))
plt.hist(num_ratings['number_of_rating'], bins=50, alpha=0.7)
plt.title('Distribution of the Number of Ratings per Book')
plt.xlabel('Number of Ratings')
plt.ylabel('Number of Books')
plt.show()
```



convert missing values

We convert our table to a 2D matrix, and fill the missing values with zeros (since we will calculate distances between rating vectors). We then transform the values(ratings) of the matrix dataframe into a scipy sparse matrix for more efficient calculations.

In [14]:
```
book_pivot.fillna(0,inplace=True)                                    # Give 0 value to non-value solts
book_pivot
```

Out[14]:

user_id	254	2276	2766	2977	3363	3757	4017	4385	6242	6251	...	274004	274061	274301	274308	274808	275970	277427	27
title																			
1984	9.0	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	0.0	0.0	0.0	
1st to Die: A Novel	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	0.0	0.0	0.0	0.0	
2nd Chance	0.0	10.0	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	0.0	0.0	
4 Blondes	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	0.0	0.0	0.0	0.0	
84 Charing Cross Road	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	0.0	0.0	10.0	0.0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Year of Wonders	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	7.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
You Belong To Me	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	0.0	0.0	0.0	0.0	
Zen and the Art of Motorcycle Maintenance: An Inquiry into Values	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	0.0	0.0	0.0	0.0	
Zoya	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	0.0	0.0	0.0	0.0	
\0\" Is for Outlaw"	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	8.0	0.0	0.0	0.0	0.0	

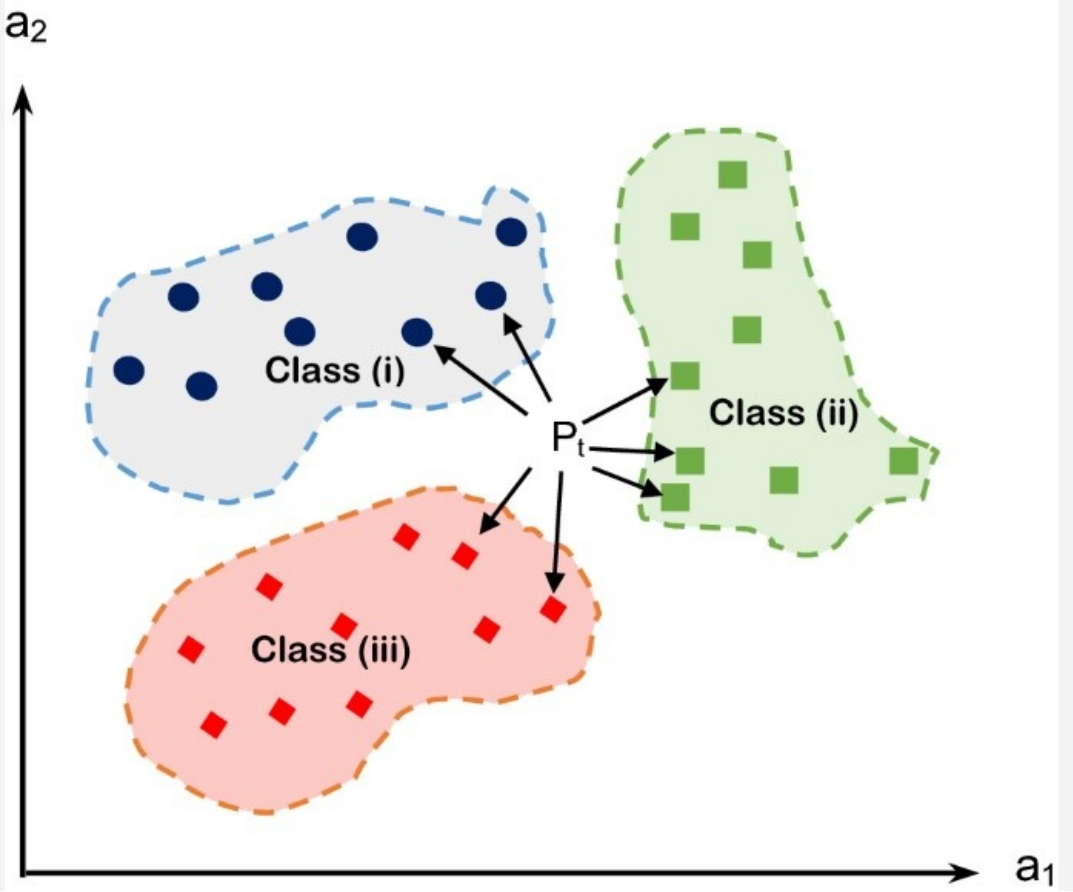
742 rows × 888 columns

- # Step 8: Model Training

This block converts the book_pivot DataFrame into a Compressed Sparse Row (CSR) matrix named book_sparse. A CSR matrix is a storage-efficient way to represent a sparse matrix where most of the elements are zeros. Sparse matrices are common in recommender systems, especially when using collaborative filtering, because not every user rates every item, leading to a lot of missing (implicitly zero) values. Converting to a CSR format helps manage memory usage and improve computation efficiency when dealing with large datasets.

In [15]:
```
book_sparse = csr_matrix(book_pivot)
model = NearestNeighbors(algorithm='brute') # Here, an instance of the NearestNeighbors class from sklearn.neig
model.fit(book_sparse)
```

Out[15]:
```
NearestNeighbors(algorithm='brute')
```



- # Step 9: Recommendation Function

In [16]:
```
def recommend_book(book_name):
    book_id = np.where(book_pivot.index == book_name)[0]
    if len(book_id) == 0:
        print("Book not found.")
        return
    distance, suggestion = model.kneighbors(book_pivot.iloc[book_id, :].values.reshape(1, -1), n_neighbors=6)
    for i in range(len(suggestion)):
        books = book_pivot.index[suggestion[i]]
        print(f"Recommendations based on {book_name}:")
        for book in books:
            print(book)
```

- # Step 10: Test the Recommendation Function

In [59]:
```
book_name = 'You Belong To Me'
recommend_book(book_name)
```

```
Recommendations based on You Belong To Me:
You Belong To Me
The Cradle Will Fall
Exclusive
Loves Music, Loves to Dance
While My Pretty One Sleeps
Before I Say Good-Bye
```

Clustering Visualization

In [75]:
```
from sklearn.decomposition import TruncatedSVD
```

```python
from sklearn.cluster import KMeans
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np

# Assuming book_pivot is already defined and is a dense DataFrame now
# If book_pivot was a sparse matrix, convert it back to dense DataFrame for TruncatedSVD
# book_sparse = csr_matrix(book_pivot)

# Dimensionality Reduction with TruncatedSVD
svd = TruncatedSVD(n_components=2, random_state=42)
book_svd = svd.fit_transform(book_pivot)  # Using the dense DataFrame directly

# Clustering with K-Means
kmeans = KMeans(n_clusters=5, random_state=42)
clusters = kmeans.fit_predict(book_svd)

# User Input for the book name
user_input_book_name = 'Year of Wonders'  # Replace with the actual book title you want to visualize

# Check if the book exists in the pivot table
if user_input_book_name in book_pivot.index:
    book_idx = np.where(book_pivot.index == user_input_book_name)[0][0]  # Get the index of the book
    book_cluster = clusters[book_idx]  # Find the cluster of the requested book

    # Visualization
    plt.figure(figsize=(12, 10))
    sns.scatterplot(x=book_svd[:, 0], y=book_svd[:, 1], hue=clusters, palette=sns.color_palette("hsv", 5), alph
    plt.scatter(book_svd[book_idx, 0], book_svd[book_idx, 1], s=200, color='black', label='Requested Book: ' +
    plt.title('SVD-Reduced Clustering of Books with Highlighted Requested Book')
    plt.xlabel('SVD Component 1')
    plt.ylabel('SVD Component 2')
    plt.legend()
    plt.show()
else:
    print("The book title you entered is not found. Please check the spelling or try another title.")
```

```
C:\Users\Hamidreza\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: FutureWarning: The default valu
e of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warnin
g
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\Hamidreza\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1436: UserWarning: KMeans is known to
have a memory leak on Windows with MKL, when there are less chunks than available threads. You can avoid it by
setting the environment variable OMP_NUM_THREADS=3.
  warnings.warn(
```