Step->0: Load PAckages and Libraries

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.metrics.pairwise import cosine_similarity
from sklearn.feature_extraction.text import TfidfVectorizer

import os
from scipy.sparse import coo_matrix
```

Step->1: Data Loading and Preprocessing

```
# Read our dataset
train_data = pd.read_csv('marketing_sample_for_walmart_com-
walmart_com_product_review__20200701_20201231__5k_data.tsv', sep='\t')
train_data.columns
```

```
Index(['Uniq Id', 'Crawl Timestamp', 'Dataset Origin', 'Product Id',
       'Product Barcode', 'Product Company Type Source',
       'Product Brand Source', 'Product Brand Normalised Source',
       'Product Name Source', 'Match Rank', 'Match Score', 'Match
Type',
       'Retailer', 'Product Category', 'Product Brand', 'Product
Name',
       'Product Price', 'Sku', 'Upc', 'Product Url', 'Market',
       'Product Description', 'Product Currency',
       'Product Available Inventory', 'Product Image Url',
       'Product Model Number', 'Product Tags', 'Product Contents',
       'Product Rating', 'Product Reviews Count', 'Bsr', 'Joining
Key'],
      dtype='object')
```

```
train_data = train_data[['Uniq Id','Product Id', 'Product Rating',
'Product Reviews Count', 'Product Category', 'Product Brand', 'Product
Name', 'Product Image Url', 'Product Description', 'Product Tags']]
train_data.head(3)
```

```
                            Uniq Id                            Product Id
\
0  1705736792d82aa2f2d3caf1c07c53f4  2e17bf4acecdece67fc00f07ad62c910

1  95a9fe6f4810fcfc7ff244fd06784f11  076e5854a62dd283c253d6bae415af1f

2  8d4d0330178d3ed181b15a4102b287f2  8a4fe5d9c7a6ed26cc44d785a454b124


   Product Rating  Product Reviews Count  \
```

```
0             NaN                    NaN
1             NaN                    NaN
2             4.5                29221.0

                                  Product Category Product Brand  \
0  Premium Beauty > Premium Makeup > Premium Nail...           OPI
1  Beauty > Hair Care > Hair Color > Auburn Hair ...   Nice'n Easy
2  Beauty > Hair Care > Hair Color > Permanent Ha...       Clairol

                                          Product Name  \
0  OPI Infinite Shine, Nail Lacquer Nail Polish, ...
1  Nice n Easy Permanent Color, 111 Natural Mediu...
2  Clairol Nice N Easy Permanent Color 7/106A Nat...

                                       Product Image Url  \
0  https://i5.walmartimages.com/asr/0e1f4c51-c1a4...
1  https://i5.walmartimages.com/asr/9c8e42e4-13a5...
2  https://i5.walmartimages.com/asr/e3a601c2-6a2b...

                                    Product Description  \
0                                                   NaN
1  Pack of 3 Pack of 3 for the UPC: 381519000201 ...
2  This Clairol Nice N Easy Permanent Color gives...

                                          Product Tags
0  OPI Infinite Shine, Nail Lacquer Nail Polish, ...
1  Nice 'n Easy Permanent Color, 111 Natural Medi...
2  Clairol Nice 'N Easy Permanent Color 7/106A Na...
```

Basic Operations

```
train_data['Product Tags']

0       OPI Infinite Shine, Nail Lacquer Nail Polish, ...
1       Nice 'n Easy Permanent Color, 111 Natural Medi...
2       Clairol Nice 'N Easy Permanent Color 7/106A Na...
3       Kokie Professional Matte Lipstick, Hot Berry, ...
4       Gillette TRAC II Plus Razor Blade Refills, Fit...
                              ...
4995    Garden Mint Room Spray (Double Strength), 4 ou...
4996    Garnier Nutrisse Nourishing Hair Color Creme (...
4997    Nail File Electric Drill, 6 in 1 Professional ...
4998    Creed Love In Black Hair And Body Wash 6.8oz/2...
4999                     Foundation, Wal-mart, Walmart.com
Name: Product Tags, Length: 5000, dtype: object

train_data.shape

(5000, 10)

train_data.isnull().sum()
```

```
Uniq Id                       0
Product Id                    0
Product Rating             2806
Product Reviews Count      1654
Product Category             10
Product Brand                13
Product Name                  0
Product Image Url             0
Product Description        1127
Product Tags                  0
dtype: int64
```

```
# Fill missing values in 'Product Rating' with a default value (e.g., 0)
train_data['Product Rating'].fillna(0, inplace=True)
# Fill missing values in 'Product Reviews Count' with a default value (e.g., 0)
train_data['Product Reviews Count'].fillna(0, inplace=True)
# Fill missing values in 'Product Category' with a default value (e.g., 'Unknown')
train_data['Product Category'].fillna('', inplace=True)
# Fill missing values in 'Product Brand' with a default value (e.g., 'Unknown')
train_data['Product Brand'].fillna('', inplace=True)
# Fill missing values in 'Product Description' with an empty string
train_data['Product Description'].fillna('', inplace=True)
```

```
C:\Users\USER\AppData\Local\Temp\ipykernel_17244\3654264793.py:2: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting values always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value) instead, to perform the operation inplace on the original object.


  train_data['Product Rating'].fillna(0, inplace=True)
C:\Users\USER\AppData\Local\Temp\ipykernel_17244\3654264793.py:4: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting values always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] =
```

```
df[col].method(value) instead, to perform the operation inplace on the
original object.


  train_data['Product Reviews Count'].fillna(0, inplace=True)
C:\Users\USER\AppData\Local\Temp\ipykernel_17244\3654264793.py:6:
FutureWarning: A value is trying to be set on a copy of a DataFrame or
Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  train_data['Product Category'].fillna('', inplace=True)
C:\Users\USER\AppData\Local\Temp\ipykernel_17244\3654264793.py:8:
FutureWarning: A value is trying to be set on a copy of a DataFrame or
Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  train_data['Product Brand'].fillna('', inplace=True)
C:\Users\USER\AppData\Local\Temp\ipykernel_17244\3654264793.py:10:
FutureWarning: A value is trying to be set on a copy of a DataFrame or
Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  train_data['Product Description'].fillna('', inplace=True)
```

```
train_data.isnull().sum()
```

```
Uniq Id                    0
Product Id                 0
Product Rating             0
Product Reviews Count      0
Product Category           0
Product Brand              0
Product Name               0
Product Image Url          0
Product Description        0
Product Tags               0
dtype: int64
```

```
train_data.duplicated().sum()
```

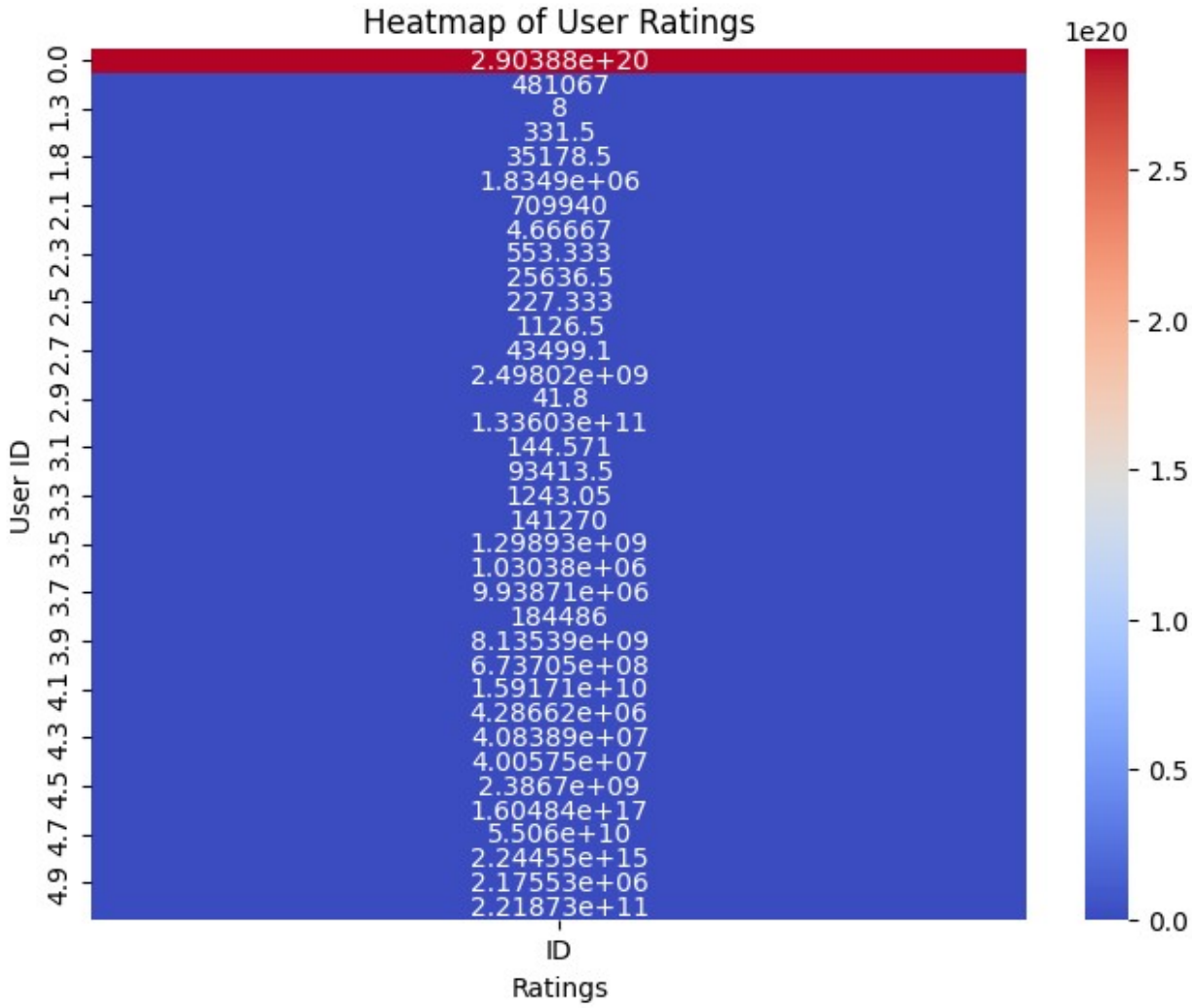
```
0
```

```
# make columns shorter
# Define the mapping of current column names to shorter names
column_name_mapping = {
    'Uniq Id': 'ID',
    'Product Id': 'ProdID',
    'Product Rating': 'Rating',
    'Product Reviews Count': 'ReviewCount',
    'Product Category': 'Category',
    'Product Brand': 'Brand',
    'Product Name': 'Name',
    'Product Image Url': 'ImageURL',
    'Product Description': 'Description',
    'Product Tags': 'Tags',
    'Product Contents': 'Contents'
}
# Rename the columns using the mapping
train_data.rename(columns=column_name_mapping, inplace=True)

train_data['ID'] = train_data['ID'].str.extract(r'(\
d+)').astype(float)
train_data['ProdID'] = train_data['ProdID'].str.extract(r'(\
d+)').astype(float)
```

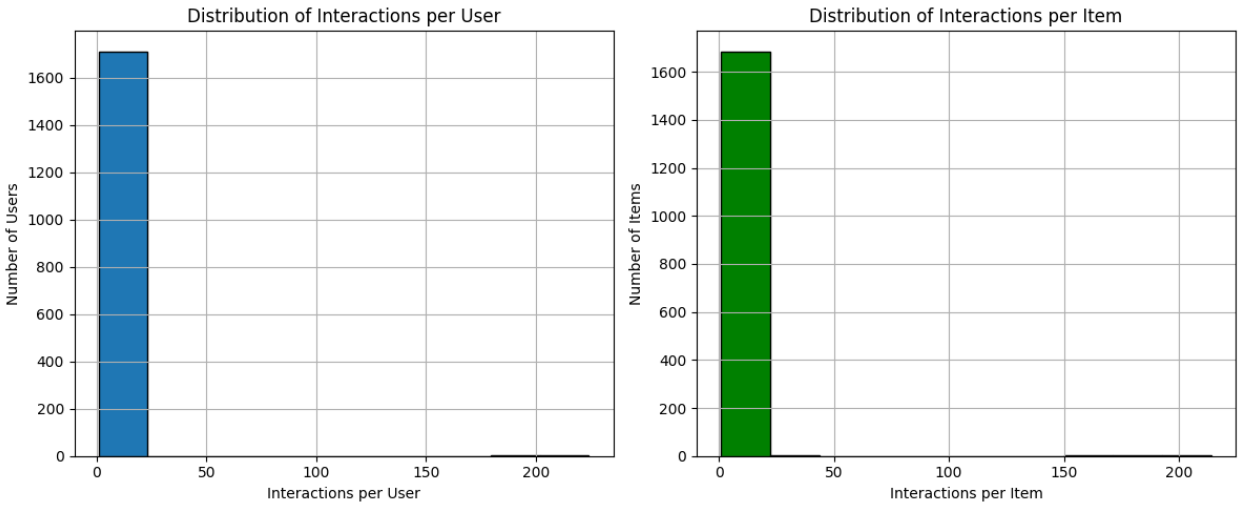
Step->2: EDA (Exploratory Data Analysis)

```
# Basic statistics
num_users = train_data['ID'].nunique()
num_items = train_data['ProdID'].nunique()
num_ratings = train_data['Rating'].nunique()
print(f"Number of unique users: {num_users}")
print(f"Number of unique items: {num_items}")
print(f"Number of unique ratings: {num_ratings}")
```

```
Number of unique users: 1721
Number of unique items: 1697
Number of unique ratings: 36

# Pivot the DataFrame to create a heatmap
heatmap_data = train_data.pivot_table('ID', 'Rating')

# Create the heatmap
plt.figure(figsize=(8, 6))
sns.heatmap(heatmap_data, annot=True, fmt='g', cmap='coolwarm',
cbar=True)
plt.title('Heatmap of User Ratings')
plt.xlabel('Ratings')
plt.ylabel('User ID')
plt.show()
```

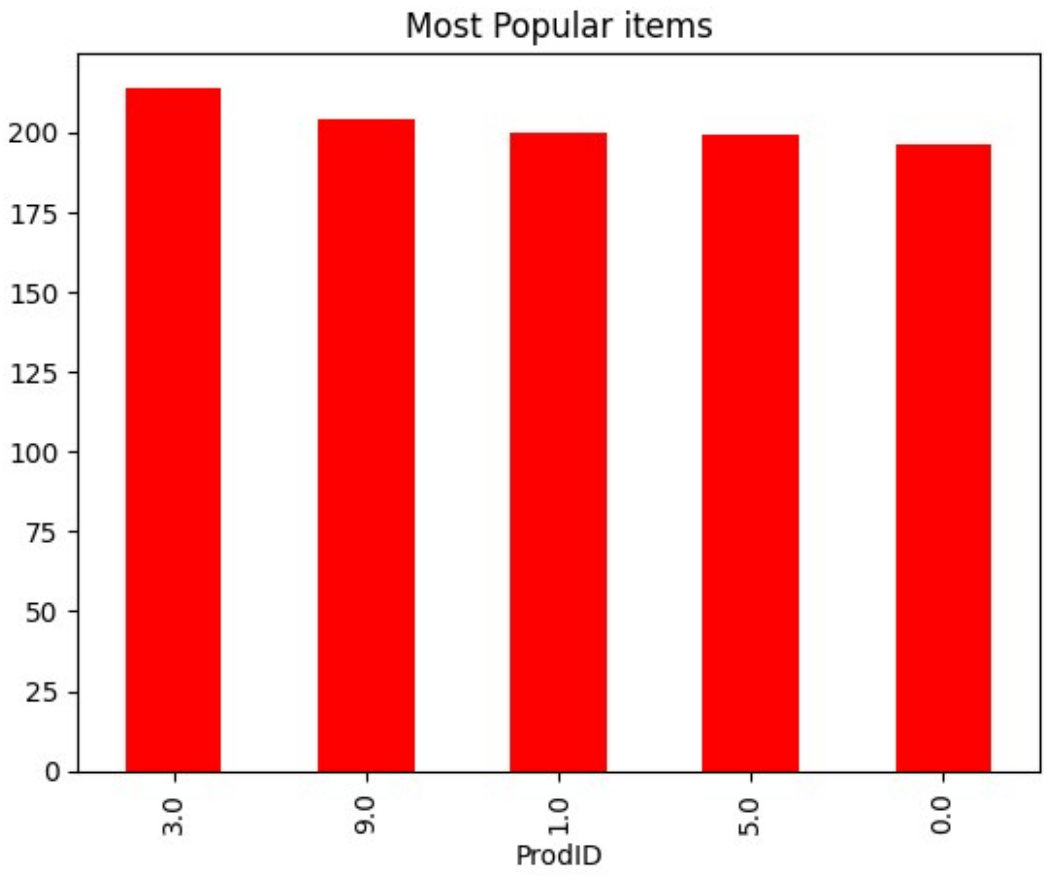


```
# Distribution of interactions
plt.figure(figsize=(12, 5))
plt.subplot(1, 2, 1)
train_data['ID'].value_counts().hist(bins=10, edgecolor='k')
plt.xlabel('Interactions per User')
plt.ylabel('Number of Users')
plt.title('Distribution of Interactions per User')

plt.subplot(1, 2, 2)
train_data['ProdID'].value_counts().hist(bins=10,
edgecolor='k',color='green')
plt.xlabel('Interactions per Item')
plt.ylabel('Number of Items')
plt.title('Distribution of Interactions per Item')

plt.tight_layout()
plt.show()
```



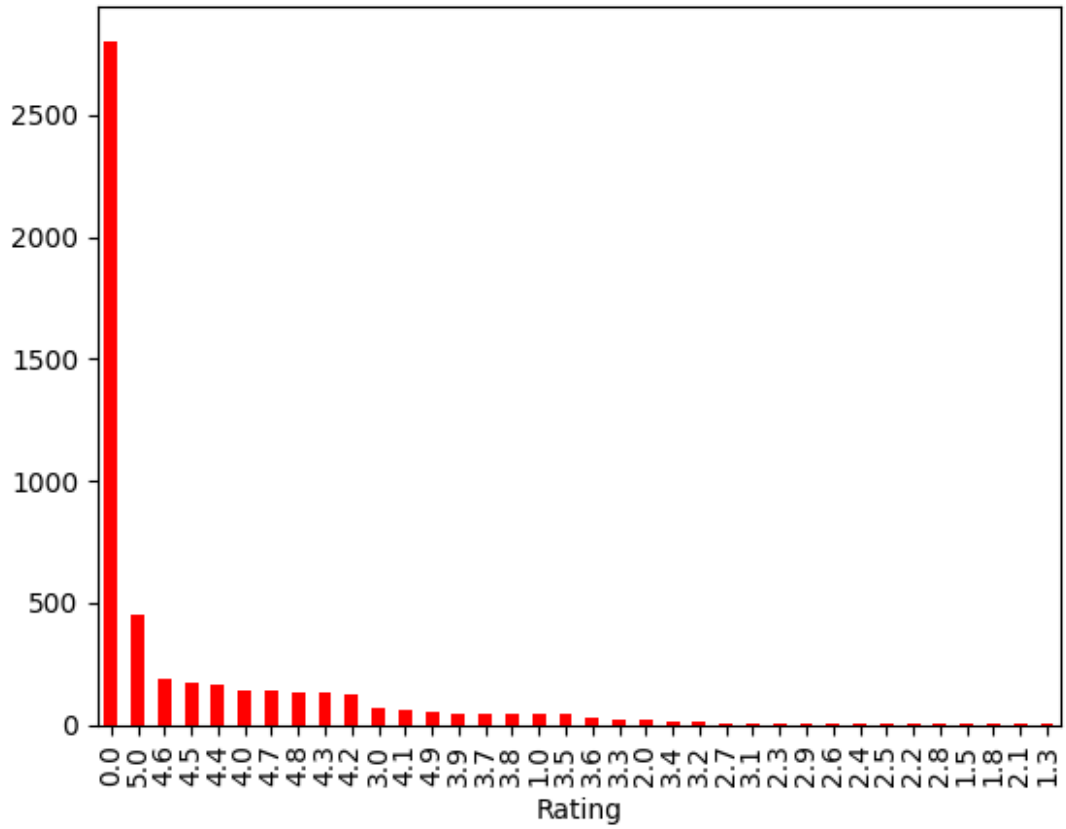

```
# Most popular items
popular_items = train_data['ProdID'].value_counts().head(5)
popular_items.plot(kind='bar',color='red')
plt.title("Most Popular items")
```

```
Text(0.5, 1.0, 'Most Popular items')
```




```
# most rated counts
train_data['Rating'].value_counts().plot(kind='bar',color='red')
```

```
<Axes: xlabel='Rating'>
```



Step->3: Data Cleaning and Tags Creations

```
import spacy
from spacy.lang.en.stop_words import STOP_WORDS

nlp = spacy.load("en_core_web_sm")

def clean_and_extract_tags(text):
    doc = nlp(text.lower())
    tags = [token.text for token in doc if token.text.isalnum() and
token.text not in STOP_WORDS]
    return ', '.join(tags)

columns_to_extract_tags_from = ['Category', 'Brand', 'Description']

for column in columns_to_extract_tags_from:
    train_data[column] =
train_data[column].apply(clean_and_extract_tags)

# Concatenate the cleaned tags from all relevant columns
train_data['Tags'] =
train_data[columns_to_extract_tags_from].apply(lambda row: ',
'.join(row), axis=1)
```

=> Rating Base Recommendations System

```
average_ratings =
train_data.groupby(['Name','ReviewCount','Brand','ImageURL'])
['Rating'].mean().reset_index()

top_rated_items = average_ratings.sort_values(by='Rating',
ascending=False)
rating_base_recommendation = top_rated_items.head(10)

rating_base_recommendation['Rating'] =
rating_base_recommendation['Rating'].astype(int)
rating_base_recommendation['ReviewCount'] =
rating_base_recommendation['ReviewCount'].astype(int)

print("Rating Base Recommendation System: (Trending Products)")
rating_base_recommendation[['Name','Rating','ReviewCount','Brand','Ima
geURL']] =
rating_base_recommendation[['Name','Rating','ReviewCount','Brand','Ima
geURL']]
rating_base_recommendation
```

```
Rating Base Recommendation System: (Trending Products)

C:\Users\USER\AppData\Local\Temp\ipykernel_17244\393183274.py:2:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy

rating_base_recommendation[['Name','Rating','ReviewCount','Brand','Ima
geURL']] =
rating_base_recommendation[['Name','Rating','ReviewCount','Brand','Ima
geURL']]

                                                   Name
ReviewCount  \
1686  Electric Shaver, Triple Shaving Time Electric ...             4

526                 Alaffia Body Lotion, Vanilla, 32 Oz             2

2053  Gold Bond Ultimate Ultimate Healing Lotion, Al...             2

4716  Versace Man Eau Fraiche Eau De Toilette Spray,...            24

2058  Goldwell StyleSign 1 Flat Marvel Straightening...             2

3842  Red Devil 0322 Steel Wool # 00 Very Fine, 8 Pa...             1
```

```
510   Air Wick Plug in Starter Kit, Warmer + 1 Refil...            1

3841  Recovery Complex Anti-Frizz Shine Serum by Bai...            4

2687  Long Aid Extra Dry Formula Curl Activator Gel ...           12

2062  Good Sense 60-Day Air Care System, Citrus, 2 o...            1


               Brand                                          ImageURL
Rating
1686         Moosoo  https://i5.walmartimages.com/asr/e7dcd553-90df...
5
526         Alaffia  https://i5.walmartimages.com/asr/2988c323-cb6f...
5
2053     Gold Bond  https://i5.walmartimages.com/asr/34b610e7-05db...
5
4716        Versace  https://i5.walmartimages.com/asr/edaaeed5-9da0...
5
2058       Goldwell  https://i5.walmartimages.com/asr/3bf90289-6980...
5
3842     Red Devil  https://i5.walmartimages.com/asr/60bfe5ba-774c...
5
510         Air Wick  https://i5.walmartimages.com/asr/0fac65b2-c6aa...
5
3841  Bain de Terre  https://i5.walmartimages.com/asr/fcdb4d2e-3727...
5
2687       Long Aid  https://i5.walmartimages.com/asr/f7f29199-bfa5...
5
2062       Diversey  https://i5.walmartimages.com/asr/025a7068-7bb1...
5
```

=>Content Base Recommendation system (User Preferences or Items similarities)

```
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.metrics.pairwise import cosine_similarity

tfidf_vectorizer = TfidfVectorizer(stop_words='english')
tfidf_matrix_content =
tfidf_vectorizer.fit_transform(train_data['Tags'])
cosine_similarities_content =
cosine_similarity(tfidf_matrix_content,tfidf_matrix_content)

item_name = 'OPI Infinite Shine, Nail Lacquer Nail Polish, Bubble
Bath'
item_index = train_data[train_data['Name']==item_name].index[0]

similar_items =
list(enumerate(cosine_similarities_content[item_index]))
```

```
similar_items = sorted(similar_items, key=lambda x:x[1], reverse=True)
top_similar_items = similar_items[1:10]

recommended_items_indics = [x[0] for x in top_similar_items]

train_data.iloc[recommended_items_indics]
[['Name','ReviewCount','Brand']]
```

	Name	ReviewCount	Brand
156	OPI Nail Lacquer Polish .5oz/15mL - This Gown ...	0.0	OPI
184	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...	0.0	OPI
205	OPI Nail Lacquer - Dont Bossa Nova Me Around -...	0.0	OPI
237	OPI Infinite Shine 2 Polish - ISL P33 - Alpaca...	5.0	OPI
325	OPI Gel Polish Fall 2019 Scotland Collection G...	1.0	OPI
375	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...	1.0	OPI
402	OPI Nail Polish, Strawberry Margarita, 0.5 Fl Oz	57.0	OPI
706	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...	1.0	OPI
886	OPI- Nail Lacquer-GelColor - &quotLiv&quotin t...	0.0	OPI

Function To Recommend Products for Content Base

```
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.metrics.pairwise import cosine_similarity

def content_based_recommendations(train_data, item_name, top_n=10):
    # Check if the item name exists in the training data
    if item_name not in train_data['Name'].values:
        print(f"Item '{item_name}' not found in the training data.")
        return pd.DataFrame()

    # Create a TF-IDF vectorizer for item descriptions
    tfidf_vectorizer = TfidfVectorizer(stop_words='english')

    # Apply TF-IDF vectorization to item descriptions
    tfidf_matrix_content =
tfidf_vectorizer.fit_transform(train_data['Tags'])

    # Calculate cosine similarity between items based on descriptions
    cosine_similarities_content =
cosine_similarity(tfidf_matrix_content, tfidf_matrix_content)
```

```
    # Find the index of the item
    item_index = train_data[train_data['Name'] == item_name].index[0]

    # Get the cosine similarity scores for the item
    similar_items =
list(enumerate(cosine_similarities_content[item_index]))

    # Sort similar items by similarity score in descending order
    similar_items = sorted(similar_items, key=lambda x: x[1],
reverse=True)

    # Get the top N most similar items (excluding the item itself)
    top_similar_items = similar_items[1:top_n+1]

    # Get the indices of the top similar items
    recommended_item_indices = [x[0] for x in top_similar_items]

    # Get the details of the top similar items
    recommended_items_details =
train_data.iloc[recommended_item_indices][['Name', 'ReviewCount',
'Brand', 'ImageURL', 'Rating']]

    return recommended_items_details

# Example: Get content-based recommendations for a specific item
item_name = 'OPI Infinite Shine, Nail Lacquer Nail Polish, Bubble
Bath'
content_based_rec = content_based_recommendations(train_data,
item_name, top_n=8)

content_based_rec
```

	Name	ReviewCount	Brand
156	OPI Nail Lacquer Polish .5oz/15mL - This Gown ...	0.0	OPI
184	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...	0.0	OPI
205	OPI Nail Lacquer - Dont Bossa Nova Me Around -...	0.0	OPI
237	OPI Infinite Shine 2 Polish - ISL P33 - Alpaca...	5.0	OPI
325	OPI Gel Polish Fall 2019 Scotland Collection G...	1.0	OPI
375	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...	1.0	OPI
402	OPI Nail Polish, Strawberry Margarita, 0.5 Fl Oz	57.0	OPI
706	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...	1.0	OPI

```
                                                  ImageURL  Rating
156  https://i5.walmartimages.com/asr/71caed3f-5f83...     0.0
184  https://i5.walmartimages.com/asr/2d6f5147-53a8...     0.0
205  https://i5.walmartimages.com/asr/fd1195d2-8d8d...     0.0
237  https://i5.walmartimages.com/asr/7426eb5c-1690...     0.0
325  https://i5.walmartimages.com/asr/79bbbd9f-9a89...     0.0
375  https://i5.walmartimages.com/asr/744e869c-3500...     5.0
402  https://i5.walmartimages.com/asr/b95676e5-96ab...     4.4
706  https://i5.walmartimages.com/asr/c7ba4815-52f7...     5.0
```

```
# Example: Get content-based recommendations for a specific item
item_name = 'Kokie Professional Matte Lipstick, Hot Berry, 0.14 fl oz'
content_based_rec = content_based_recommendations(train_data,
item_name, top_n=8)

content_based_rec
```

```
                                                  Name
ReviewCount  \
3406  Kokie Professional Matte Lipstick, Firecracker...          0.0

546   Kokie Professional Matte Lipstick, Kiss Me, 0....          0.0

4050  Kokie Professional Lip Poudre Liquid Matte Liq...          7.0

2406          L.A. Colors Matte Lipstick, Tender Matte          3.0

2873  Kokie Professional Lip Poudre Liquid Matte Liq...          7.0

4084         e.l.f. Mad for Matte 4 Piece Lip Color Set          0.0

1559  LOreal Paris Colour Riche Matte Lip Liner, Mat...        495.0

3023                           Be Matte Lipstick - Pink          2.0


                  Brand
ImageURL  \
3406   Kokie Cosmetics  https://i5.walmartimages.com/asr/8312221b-
ed22...
546    Kokie Cosmetics  https://i5.walmartimages.com/asr/27dd82a2-
2b9c...
4050   Kokie Cosmetics  https://i5.walmartimages.com/asr/fdd7498c-
319f...
2406       L.A. Colors  https://i5.walmartimages.com/asr/271264fb-
e8c3...
2873   Kokie Cosmetics  https://i5.walmartimages.com/asr/31c99d9b-
ea11...
4084  e.l.f. Cosmetics  https://i5.walmartimages.com/asr/e2d30304-
edc9...
```

```
1559     L'Oreal Paris  https://i5.walmartimages.com/asr/baf97085-
7231...
3023        City Color  https://i5.walmartimages.com/asr/4425a13e-
085f...

      Rating
3406     0.0
546      0.0
4050     3.4
2406     3.7
2873     3.4
4084     0.0
1559     4.4
3023     3.0
```

=>Collaborative Filtering (User Item Similarity)

```
user_item_matrix = train_data.pivot_table(index='ID',
columns='ProdID',
values='Rating',aggfunc='mean').fillna(0).astype(int)

user_similarity = cosine_similarity(user_item_matrix)

target_user_id = 4
target_user_index = user_item_matrix.index.get_loc(target_user_id)

user_similarities = user_similarity[target_user_index]
similar_user_indices = user_similarities.argsort()[::-1][1:]

recommend_items = []

for user_index in similar_user_indices:
    rated_by_similar_user = user_item_matrix.iloc[user_index]
    not_rated_by_target_user = (rated_by_similar_user==0) &
(user_item_matrix.iloc[target_user_index]==0)


recommend_items.extend(user_item_matrix.columns[not_rated_by_target_us
er][:10])

recommended_items_details =
train_data[train_data['ProdID'].isin(recommend_items)]
[['Name','ReviewCount','Brand','ImageURL','Rating']]

recommended_items_details.head(10)
```

```
                                                 Name  ReviewCount  \
15   Clairol Natural Instincts Demi-Permanent Hair ...       2935.0
33   DenTek Kids Fun Flossers, Removes Food & Plaqu...          3.0
61   COVERGIRL Exhibitionist Cream Lipstick, 395 Da...        713.0
64   Neutrogena SkinClearing Oil-Free Liquid Founda...        741.0
```

```
69   Design Essentials Natural Coconut & Monoi Curl...          1.0
78   Paul Sebastian Fine Cologne Spray, Cologne for...         28.0
85   BioAstin Hawaiian Astaxanthin, Vegan, 12mg, 75 Ct          3.0
92         Bytewise Organic Moringa Leaf Powder, 12 Oz          0.0
94   Ag Hair Cosmetics Ultradynamics Extra-Firm Fin...          0.0
108  OPI Nail Dipping Powder Perfection Combo - Liq...          1.0

                  Brand
ImageURL  \
15              Clairol  https://i5.walmartimages.com/asr/00a6e54a-
e431...
33               DenTek  https://i5.walmartimages.com/asr/de6e52eb-
6e18...
61            COVERGIRL  https://i5.walmartimages.com/asr/95076ec0-
ffbd...
64           Neutrogena  https://i5.walmartimages.com/asr/fd4d78d8-
310a...
69   Design Essentials  https://i5.walmartimages.com/asr/ff2dba1d-
0c02...
78      Paul Sebastian  https://i5.walmartimages.com/asr/03d08a07-
18d7...
85             Bioastin  https://i5.walmartimages.com/asr/6da9e238-
b19e...
92             Bytewise  https://i5.walmartimages.com/asr/076f2b3f-
fdc3...
94              AG Hair  https://i5.walmartimages.com/asr/5d217d98-
a385...
108                OPI  https://i5.walmartimages.com/asr/ef1607ee-
5bdb...

     Rating
15      3.7
33      0.0
61      4.3
64      4.2
69      5.0
78      4.8
85      5.0
92      0.0
94      0.0
108     3.0
```

Function That Recommend Items

```python
def collaborative_filtering_recommendations(train_data,
target_user_id, top_n=10):
    # Create the user-item matrix
    user_item_matrix = train_data.pivot_table(index='ID',
columns='ProdID', values='Rating', aggfunc='mean').fillna(0)
```

```
    # Calculate the user similarity matrix using cosine similarity
    user_similarity = cosine_similarity(user_item_matrix)

    # Find the index of the target user in the matrix
    target_user_index = user_item_matrix.index.get_loc(target_user_id)

    # Get the similarity scores for the target user
    user_similarities = user_similarity[target_user_index]

    # Sort the users by similarity in descending order (excluding the
target user)
    similar_users_indices = user_similarities.argsort()[::-1][1:]

    # Generate recommendations based on similar users
    recommended_items = []

    for user_index in similar_users_indices:
        # Get items rated by the similar user but not by the target
user
        rated_by_similar_user = user_item_matrix.iloc[user_index]
        not_rated_by_target_user = (rated_by_similar_user == 0) &
(user_item_matrix.iloc[target_user_index] == 0)

        # Extract the item IDs of recommended items

recommended_items.extend(user_item_matrix.columns[not_rated_by_target_
user][:top_n])

    # Get the details of recommended items
    recommended_items_details =
train_data[train_data['ProdID'].isin(recommended_items)][['Name',
'ReviewCount', 'Brand', 'ImageURL', 'Rating']]

    return recommended_items_details.head(10)

# Example usage
target_user_id = 4
top_n = 5
collaborative_filtering_rec =
collaborative_filtering_recommendations(train_data, target_user_id)
print(f"Top {top_n} recommendations for User {target_user_id}:")
collaborative_filtering_rec
```

```
Top 5 recommendations for User 4:
```

	Name	ReviewCount	\
61	COVERGIRL Exhibitionist Cream Lipstick, 395 Da...	713.0	
85	BioAstin Hawaiian Astaxanthin, Vegan, 12mg, 75 Ct	3.0	
86	LOreal Paris Feria Multi-Faceted Shimmering Pe...	2144.0	
108	OPI Nail Dipping Powder Perfection Combo - Liq...	1.0	
144	Covidien Curity Maternity Pad Heavy 4.33&quot ...	0.0	

```
155  Crest 3D White Brilliance Mouthwash, Alcohol F...          63.0
174  COVERGIRL Outlast All-Day Moisturizing Lip Col...          36.0
193  Revlon ColorStay Skinny Liquid Liner, 304 Gree...          70.0
212  Comvita Certified UMF 20+ Manuka Honey, Raw & ...           0.0
241              Ahava Mens Mineral Hand Cream, 3.4 Oz           0.0

              Brand                                           ImageURL
Rating
61       COVERGIRL  https://i5.walmartimages.com/asr/95076ec0-ffbd...
4.3
85        Bioastin  https://i5.walmartimages.com/asr/6da9e238-b19e...
5.0
86   L'Oreal Paris  https://i5.walmartimages.com/asr/c229026a-2b75...
3.1
108            OPI  https://i5.walmartimages.com/asr/ef1607ee-5bdb...
3.0
144       Covidien  https://i5.walmartimages.com/asr/e4e38217-ed43...
0.0
155          Crest  https://i5.walmartimages.com/asr/1fcc5525-9ae3...
0.0
174      COVERGIRL  https://i5.walmartimages.com/asr/4479896f-c6c4...
0.0
193         Revlon  https://i5.walmartimages.com/asr/aa3b20a6-3d6d...
4.5
212        Comvita  https://i5.walmartimages.com/asr/3cdc1498-a2ac...
0.0
241          Ahava  https://i5.walmartimages.com/asr/f74e4bb7-47d3...
0.0
```

=> Hybrid Recommendations

```
# Hybrid Recommendations (Combine Content-Based and Collaborative
Filtering)
def hybrid_recommendations(train_data,target_user_id, item_name,
top_n=10):
    # Get content-based recommendations
    content_based_rec =
content_based_recommendations(train_data,item_name, top_n)

    # Get collaborative filtering recommendations
    collaborative_filtering_rec =
collaborative_filtering_recommendations(train_data,target_user_id,
top_n)

    # Merge and deduplicate the recommendations
    hybrid_rec = pd.concat([content_based_rec,
collaborative_filtering_rec]).drop_duplicates()

    return hybrid_rec.head(10)
```

```
# Example usage: Get hybrid recommendations for a specific user and
item
target_user_id = 4 # Change this to the user_id you want
recommendations for
item_name = "OPI Nail Lacquer Polish .5oz/15mL - This Gown Needs A
Crown NL U11"  # Change this to the item name
hybrid_rec = hybrid_recommendations(train_data,target_user_id,
item_name, top_n=10)

print(f"Top 10 Hybrid Recommendations for User {target_user_id} and
Item '{item_name}':")
hybrid_rec
```

```
Top 10 Hybrid Recommendations for User 4 and Item 'OPI Nail Lacquer
Polish .5oz/15mL - This Gown Needs A Crown NL U11':
```

	Name	ReviewCount	Brand	\
156	OPI Nail Lacquer Polish .5oz/15mL - This Gown ...	0.0	OPI	
184	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...	0.0	OPI	
205	OPI Nail Lacquer - Dont Bossa Nova Me Around -...	0.0	OPI	
237	OPI Infinite Shine 2 Polish - ISL P33 - Alpaca...	5.0	OPI	
325	OPI Gel Polish Fall 2019 Scotland Collection G...	1.0	OPI	
375	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...	1.0	OPI	
402	OPI Nail Polish, Strawberry Margarita, 0.5 Fl Oz	57.0	OPI	
706	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...	1.0	OPI	
886	OPI- Nail Lacquer-GelColor - &quotLiv&quotin t...	0.0	OPI	
1042	OPI GelColor Gel Nail Polish, Dulce De Leche, ...	1.0	OPI	

	ImageURL	Rating
156	https://i5.walmartimages.com/asr/71caed3f-5f83...	0.0
184	https://i5.walmartimages.com/asr/2d6f5147-53a8...	0.0
205	https://i5.walmartimages.com/asr/fd1195d2-8d8d...	0.0
237	https://i5.walmartimages.com/asr/7426eb5c-1690...	0.0
325	https://i5.walmartimages.com/asr/79bbbd9f-9a89...	0.0
375	https://i5.walmartimages.com/asr/744e869c-3500...	5.0
402	https://i5.walmartimages.com/asr/b95676e5-96ab...	4.4
706	https://i5.walmartimages.com/asr/c7ba4815-52f7...	5.0
886	https://i5.walmartimages.com/asr/98b4194c-e026...	0.0
1042	https://i5.walmartimages.com/asr/c1b2c370-b2d2...	0.0

```
# Example usage: Get hybrid recommendations for a specific user and item
target_user_id = 10 # Change this to the user_id you want recommendations for
item_name = 'Black Radiance Perfect Tone Matte Lip Crème, Succulent Plum'

hybrid_rec = hybrid_recommendations(train_data,target_user_id, item_name, top_n=10)

print(f"Top 10 Hybrid Recommendations for User {target_user_id} and Item '{item_name}':")
hybrid_rec
```

```
Top 10 Hybrid Recommendations for User 10 and Item 'Black Radiance Perfect Tone Matte Lip Crème, Succulent Plum':

                                                   Name
ReviewCount  \
896   Black Radiance Perfect Tone Lip Color, Vintage...          78.0

2496  Black Radiance Perfect Tone Lip Color, Hollywo...          18.0

2406           L.A. Colors Matte Lipstick, Tender Matte           3.0

3     Kokie Professional Matte Lipstick, Hot Berry, ...           0.0

3406  Kokie Professional Matte Lipstick, Firecracker...           0.0

2873  Kokie Professional Lip Poudre Liquid Matte Liq...           7.0

4050  Kokie Professional Lip Poudre Liquid Matte Liq...           7.0

4872           L.A. Colors Matte Lipstick, Torrid Matte           8.0

420   Black Opal Color Splurge Sassy Luxe Matte Lips...           0.0

1300             e.l.f. Liquid Matte Lipstick, Tea Rose         476.0


                  Brand
ImageURL  \
896     Black Radiance  https://i5.walmartimages.com/asr/485f26b4-
a19a...
2496    Black Radiance  https://i5.walmartimages.com/asr/fe3da48f-
5142...
2406       L.A. Colors  https://i5.walmartimages.com/asr/271264fb-
e8c3...
3      Kokie Cosmetics  https://i5.walmartimages.com/asr/25b4b467-
bc61...
3406   Kokie Cosmetics  https://i5.walmartimages.com/asr/8312221b-
```

```
ed22...
2873   Kokie Cosmetics  https://i5.walmartimages.com/asr/31c99d9b-
ea11...
4050   Kokie Cosmetics  https://i5.walmartimages.com/asr/fdd7498c-
319f...
4872       L.A. Colors  https://i5.walmartimages.com/asr/62d6d9fa-
eee1...
420          Black Opal  https://i5.walmartimages.com/asr/a991241b-
e4ad...
1300  e.l.f. Cosmetics  https://i5.walmartimages.com/asr/58220de4-
3875...

      Rating
896      4.7
2496     4.3
2406     3.7
3        0.0
3406     0.0
2873     3.4
4050     3.4
4872     4.8
420      0.0
1300     4.1
```