

```
In [19]: 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
```

```
In [2]: train_data = pd.read_csv('marketing_sample_for_walmart_com-walmart_com_product_rev
train_data.columns
```

```
Out[2]: 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')
```

```
In [3]: train_data = train_data[['Uniq Id', 'Product Id', 'Product Rating', 'Product Reviews
train_data.head()
```

Out[3]:

	Uniq Id	Product Id	Product Rating	Product Reviews Count	Prod Cat
0	1705736792d82aa2f2d3caf1c07c53f4	2e17bf4acecdce67fc00f07ad62c910	NaN	NaN	Pr Be Pr Mal Pr
1	95a9fe6f4810fcfc7ff244fd06784f11	076e5854a62dd283c253d6bae415af1f	NaN	NaN	Be Ha C A
2	8d4d0330178d3ed181b15a4102b287f2	8a4fe5d9c7a6ed26cc44d785a454b124	4.5	29221.0	Be Ha C Perr
3	fddc4df45b35efd886794b261f730c51	03b5fb878a33eadff8b033419eab9669	NaN	NaN	Be Mal
4	0990cf89a59ca6a0460349a3e4f51d42	ce3d761e57d6ccad80619297b5b1bcfc	NaN	131.0	Se > Ess > Pe



In [4]: `train_data['Product Tags']`

Out[4]:

```
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
```

In [5]: `train_data.shape`

Out[5]: (5000, 10)

In [6]: `train_data.isnull().sum()`

```
Out[6]:
```

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

```
In [7]:
```

```
# 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)
```

```
In [8]:
```

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

```
Out[8]:
```

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

```
In [9]:
```

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

```
Out[9]:
```

```
0
```

```
In [10]:
```

```
# 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)
```

```
In [11]:
```

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

In [12]:

```
# 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

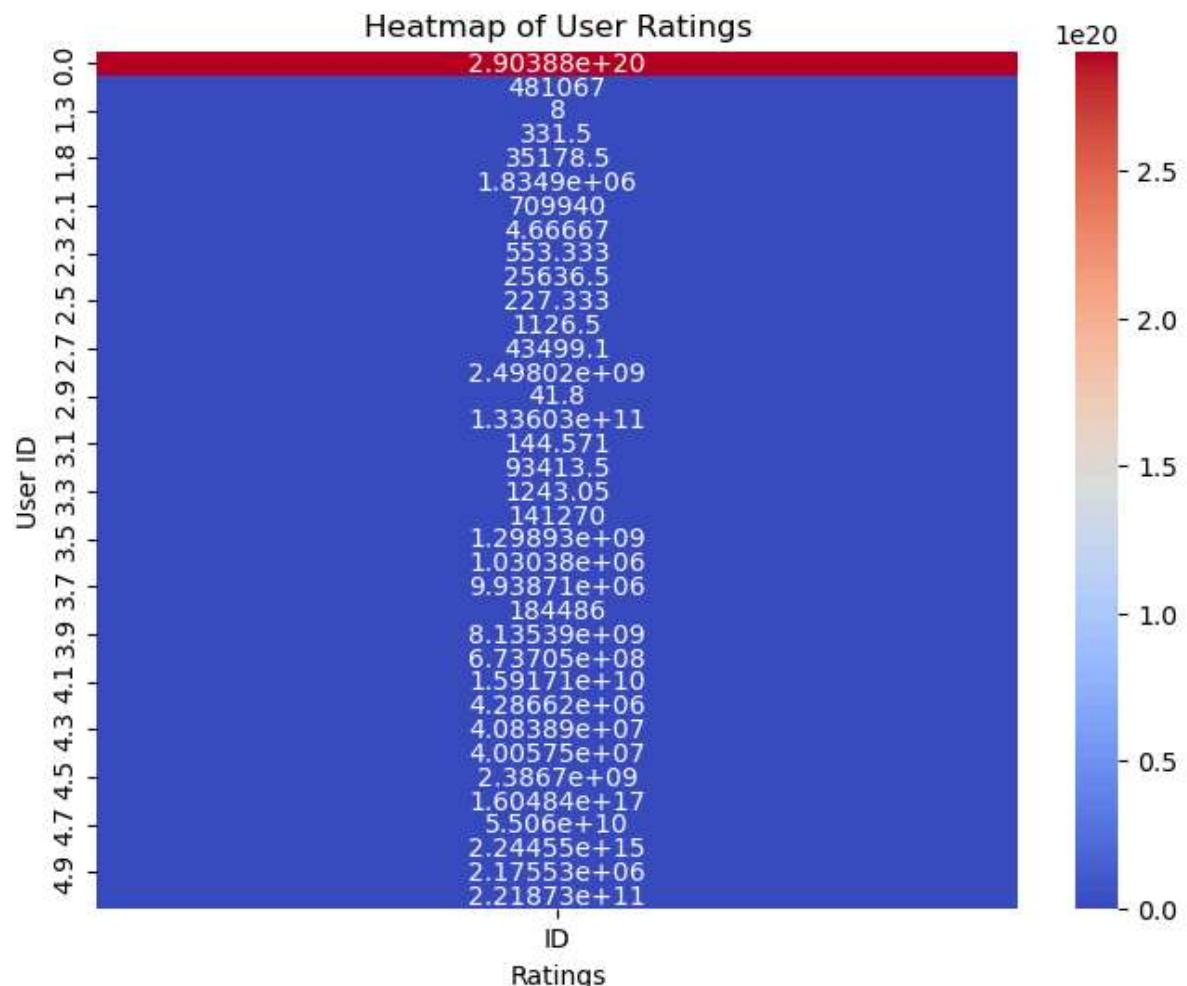
Number of unique items: 1697

Number of unique ratings: 36

In [13]:

```
# 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()
```



In [14]:

```
# 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')

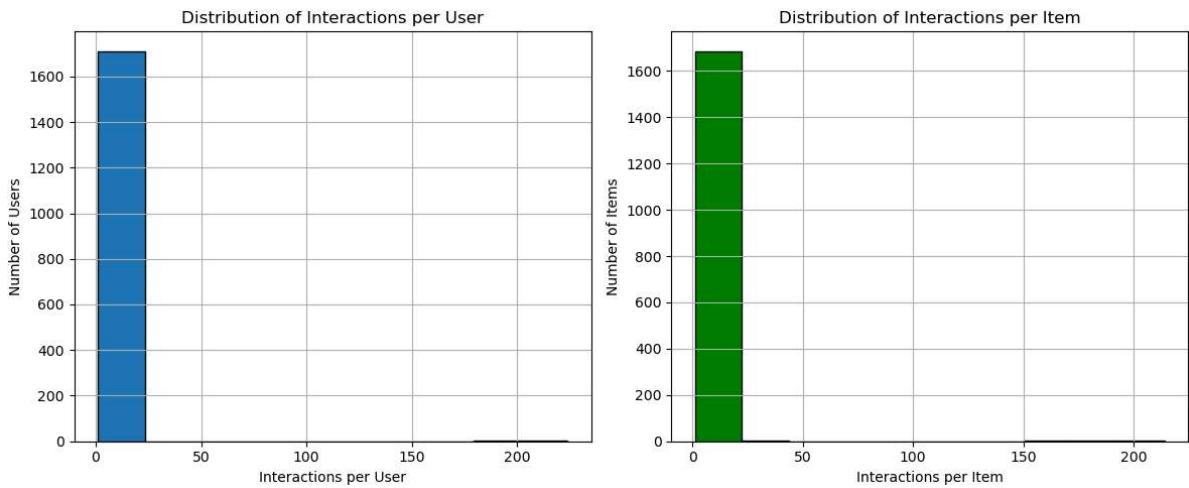
plt.subplot(1, 2, 2)
```

```

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()

```

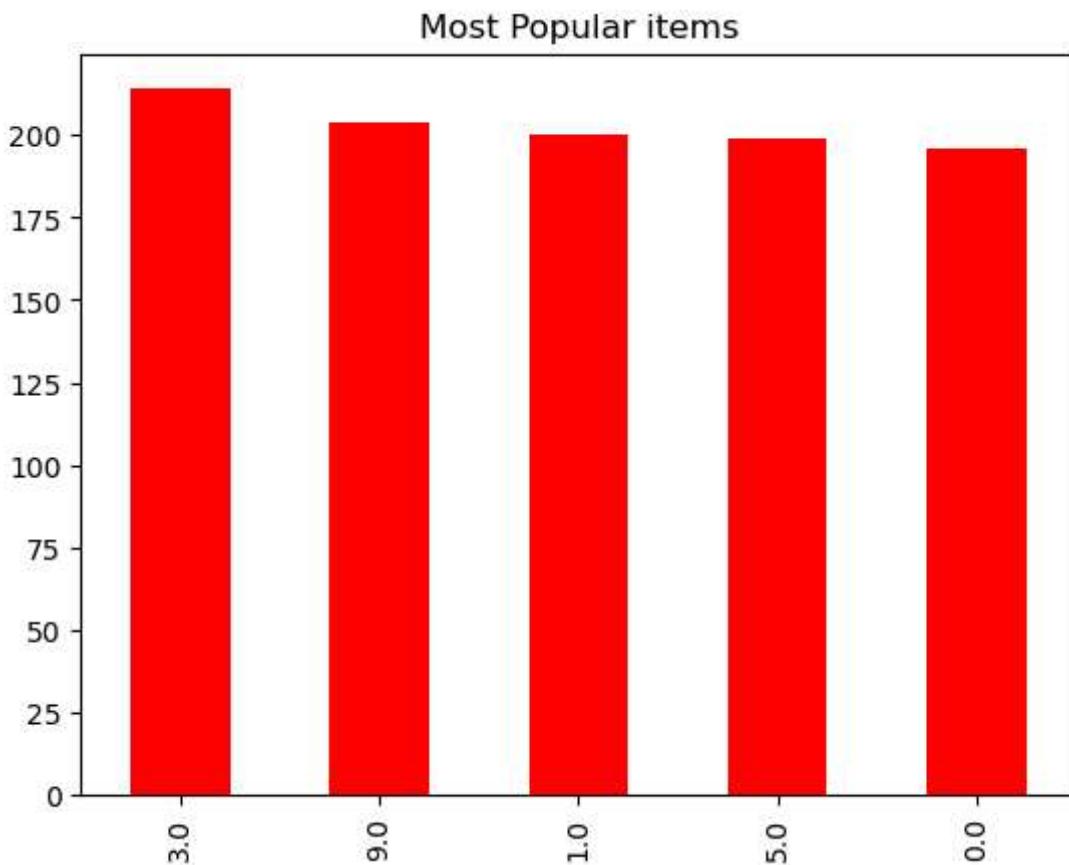


```

In [15]: # Most popular items
popular_items = train_data['ProdID'].value_counts().head(5)
popular_items.plot(kind='bar', color='red')
plt.title("Most Popular items")

```

Out[15]: Text(0.5, 1.0, 'Most Popular items')

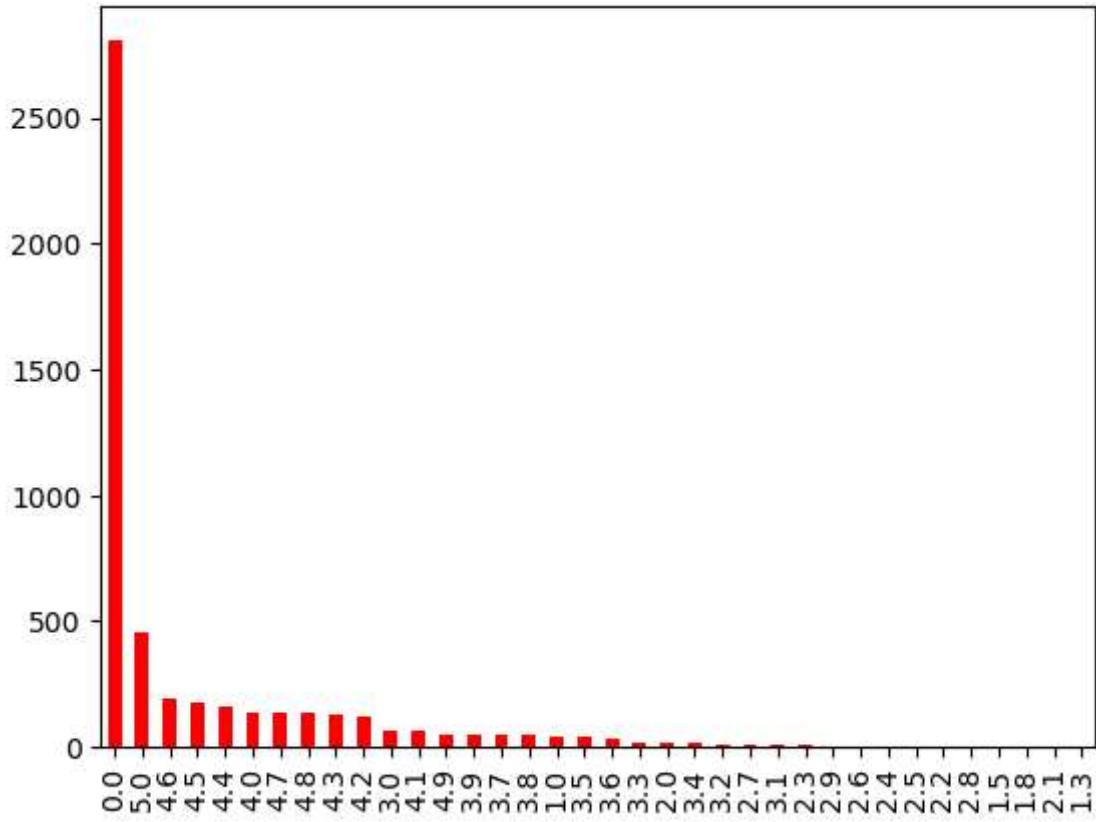


```

In [16]: # most rated counts
train_data['Rating'].value_counts().plot(kind='bar', color='red')

```

Out[16]: <AxesSubplot:>



```
In [24]: !pip install spacy
import spacy
from spacy.lang.en.stop_words import STOP_WORDS
```

Requirement already satisfied: spacy in f:\ml\anaconda\lib\site-packages (3.8.3)
Requirement already satisfied: catalogue<2.1.0,>=2.0.6 in f:\ml\anaconda\lib\site-packages (from spacy) (2.0.10)
Requirement already satisfied: numpy>=1.19.0 in f:\ml\anaconda\lib\site-packages (from spacy) (1.21.5)
Requirement already satisfied: pydantic!=1.8,!>=1.8.1,<3.0.0,>=1.7.4 in f:\ml\anaconda\lib\site-packages (from spacy) (2.10.6)
Requirement already satisfied: thinc<8.4.0,>=8.3.0 in f:\ml\anaconda\lib\site-packages (from spacy) (8.3.4)
Requirement already satisfied: tqdm<5.0.0,>=4.38.0 in f:\ml\anaconda\lib\site-packages (from spacy) (4.64.1)
Requirement already satisfied: murmurhash<1.1.0,>=0.28.0 in f:\ml\anaconda\lib\site-packages (from spacy) (1.0.12)
Requirement already satisfied: spacy-loggers<2.0.0,>=1.0.0 in f:\ml\anaconda\lib\site-packages (from spacy) (1.0.5)
Requirement already satisfied: cymem<2.1.0,>=2.0.2 in f:\ml\anaconda\lib\site-packages (from spacy) (2.0.11)
Requirement already satisfied: spacy-legacy<3.1.0,>=3.0.11 in f:\ml\anaconda\lib\site-packages (from spacy) (3.0.12)
Requirement already satisfied: weasel<0.5.0,>=0.1.0 in f:\ml\anaconda\lib\site-packages (from spacy) (0.4.1)
Requirement already satisfied: preshed<3.1.0,>=3.0.2 in f:\ml\anaconda\lib\site-packages (from spacy) (3.0.9)
Requirement already satisfied: requests<3.0.0,>=2.13.0 in f:\ml\anaconda\lib\site-packages (from spacy) (2.28.1)
Requirement already satisfied: srsly<3.0.0,>=2.4.3 in f:\ml\anaconda\lib\site-packages (from spacy) (2.5.1)
Requirement already satisfied: packaging>=20.0 in f:\ml\anaconda\lib\site-packages (from spacy) (21.3)
Requirement already satisfied: wasabi<1.2.0,>=0.9.1 in f:\ml\anaconda\lib\site-packages (from spacy) (1.1.3)
Requirement already satisfied: typer<1.0.0,>=0.3.0 in f:\ml\anaconda\lib\site-packages (from spacy) (0.15.2)
Requirement already satisfied: jinja2 in f:\ml\anaconda\lib\site-packages (from spacy) (2.11.3)
Requirement already satisfied: langcodes<4.0.0,>=3.2.0 in f:\ml\anaconda\lib\site-packages (from spacy) (3.5.0)
Requirement already satisfied: setuptools in f:\ml\anaconda\lib\site-packages (from spacy) (63.4.1)
Requirement already satisfied: language-data>=1.2 in f:\ml\anaconda\lib\site-packages (from langcodes<4.0.0,>=3.2.0->spacy) (1.3.0)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in f:\ml\anaconda\lib\site-packages (from packaging>=20.0->spacy) (3.0.9)
Requirement already satisfied: annotated-types>=0.6.0 in f:\ml\anaconda\lib\site-packages (from pydantic!=1.8,!>=1.8.1,<3.0.0,>=1.7.4->spacy) (0.7.0)
Requirement already satisfied: pydantic-core==2.27.2 in f:\ml\anaconda\lib\site-packages (from pydantic!=1.8,!>=1.8.1,<3.0.0,>=1.7.4->spacy) (2.27.2)
Requirement already satisfied: typing-extensions>=4.12.2 in f:\ml\anaconda\lib\site-packages (from pydantic!=1.8,!>=1.8.1,<3.0.0,>=1.7.4->spacy) (4.12.2)
Requirement already satisfied: charset-normalizer<3,>=2 in f:\ml\anaconda\lib\site-packages (from requests<3.0.0,>=2.13.0->spacy) (2.0.4)
Requirement already satisfied: certifi>=2017.4.17 in f:\ml\anaconda\lib\site-packages (from requests<3.0.0,>=2.13.0->spacy) (2022.9.14)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in f:\ml\anaconda\lib\site-packages (from requests<3.0.0,>=2.13.0->spacy) (1.26.11)
Requirement already satisfied: idna<4,>=2.5 in f:\ml\anaconda\lib\site-packages (from requests<3.0.0,>=2.13.0->spacy) (3.3)
Requirement already satisfied: bliss<1.3.0,>=1.2.0 in f:\ml\anaconda\lib\site-packages (from thinc<8.4.0,>=8.3.0->spacy) (1.2.0)
Requirement already satisfied: confection<1.0.0,>=0.0.1 in f:\ml\anaconda\lib\site-packages (from thinc<8.4.0,>=8.3.0->spacy) (0.1.5)
Requirement already satisfied: colorama in f:\ml\anaconda\lib\site-packages (from tqdm<5.0.0,>=4.38.0->spacy) (0.4.6)
Requirement already satisfied: rich>=10.11.0 in f:\ml\anaconda\lib\site-packages

```
(from typer<1.0.0,>=0.3.0->spacy) (13.9.4)
Requirement already satisfied: shellingham>=1.3.0 in f:\ml\anaconda\lib\site-packages (from typer<1.0.0,>=0.3.0->spacy) (1.5.4)
Requirement already satisfied: click>=8.0.0 in f:\ml\anaconda\lib\site-packages (from typer<1.0.0,>=0.3.0->spacy) (8.0.4)
Requirement already satisfied: cloudpathlib<1.0.0,>=0.7.0 in f:\ml\anaconda\lib\site-packages (from weasel<0.5.0,>=0.1.0->spacy) (0.20.0)
Requirement already satisfied: smart-open<8.0.0,>=5.2.1 in f:\ml\anaconda\lib\site-packages (from weasel<0.5.0,>=0.1.0->spacy) (5.2.1)
Requirement already satisfied: MarkupSafe>=0.23 in f:\ml\anaconda\lib\site-packages (from jinja2->spacy) (2.0.1)
Requirement already satisfied: marisa-trie>=1.1.0 in f:\ml\anaconda\lib\site-packages (from language-data>=1.2->langcodes<4.0.0,>=3.2.0->spacy) (1.2.1)
Requirement already satisfied: markdown-it-py>=2.2.0 in f:\ml\anaconda\lib\site-packages (from rich>=10.11.0->typer<1.0.0,>=0.3.0->spacy) (3.0.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in f:\ml\anaconda\lib\site-packages (from rich>=10.11.0->typer<1.0.0,>=0.3.0->spacy) (2.19.1)
Requirement already satisfied: mdurl~0.1 in f:\ml\anaconda\lib\site-packages (from markdown-it-py>=2.2.0->rich>=10.11.0->typer<1.0.0,>=0.3.0->spacy) (0.1.2)
```

In [26]: `!python -m spacy download en_core_web_sm`

```
Collecting en-core-web-sm==3.8.0
  Downloading https://github.com/explosion/spacy-models/releases/download/en_core_web_sm-3.8.0/en_core_web_sm-3.8.0-py3-none-any.whl (12.8 MB)
----- 12.8/12.8 MB 5.8 MB/s eta 0:00:00
Installing collected packages: en-core-web-sm
Successfully installed en-core-web-sm-3.8.0
[+] Download and installation successful
You can now load the package via spacy.load('en_core_web_sm')
```

In [27]: `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
           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)
```

In [28]: `# Concatenate the cleaned tags from all relevant columns`
`train_data['Tags'] = train_data[columns_to_extract_tags_from].apply(lambda row: ',`

In [29]: `average_ratings = train_data.groupby(['Name', 'ReviewCount', 'Brand', 'ImageURL'])['Ra`

In [30]: `top_rated_items = average_ratings.sort_values(by='Rating', ascending=False)`
`rating_base_recommendation = top_rated_items.head(10)`

In [31]: `rating_base_recommendation['Rating'] = rating_base_recommendation['Rating'].astype(`
`rating_base_recommendation['ReviewCount'] = rating_base_recommendation['ReviewCount`

```
C:\Users\bordi\AppData\Local\Temp\ipykernel_37184\565725879.py:1: 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['Rating'] = rating_base_recommendation['Rating'].astype(int)  
C:\Users\bordi\AppData\Local\Temp\ipykernel_37184\565725879.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['ReviewCount'] = rating_base_recommendation['ReviewCount'].astype(int)
```

```
In [32]: print("Rating Base Recommendation System: (Trending Products)")  
rating_base_recommendation[['Name','Rating','ReviewCount','Brand','ImageURL']] = ra  
rating_base_recommendation
```

```
Rating Base Recommendation System: (Trending Products)  
C:\Users\bordi\AppData\Local\Temp\ipykernel_37184\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','ImageURL']] = ra  
rating_base_recommendation[['Name','Rating','ReviewCount','Brand','ImageURL']]
```

Out[32]:

	Name	ReviewCount	Brand	ImageURL	Rating
1686	Electric Shaver, Triple Shaving Time Electric ...	4	moosoo	https://i5.walmartimages.com/asr/e7dc553-90df...	5
526	Alaffia Body Lotion, Vanilla, 32 Oz	2	alaffia	https://i5.walmartimages.com/asr/2988c323-cb6f...	5
2053	Gold Bond Ultimate Ultimate Healing Lotion, Al...	2	gold, bond	https://i5.walmartimages.com/asr/34b610e7-05db...	5
4716	Versace Man Eau Fraiche Eau De Toilette Spray,...	24	versace	https://i5.walmartimages.com/asr/edaaeed5-9da0...	5
2058	Goldwell StyleSign 1 Flat Marvel Straightening...	2	goldwell	https://i5.walmartimages.com/asr/3bf90289-6980...	5
3842	Red Devil 0322 Steel Wool # 00 Very Fine, 8 Pa...	1	red, devil	https://i5.walmartimages.com/asr/60bfe5ba-774c...	5
510	Air Wick Plug in Starter Kit, Warmer + 1 Refil...	1	air, wick	https://i5.walmartimages.com/asr/0fac65b2-c6aa...	5
3841	Recovery Complex Anti-Frizz Shine Serum by Bai...	4	bain, de, terre	https://i5.walmartimages.com/asr/fcdb4d2e-3727...	5
2687	Long Aid Extra Dry Formula Curl Activator Gel ...	12	long, aid	https://i5.walmartimages.com/asr/f7f29199-bfa5...	5
2062	Good Sense 60-Day Air Care System, Citrus, 2 o...	1	diversey	https://i5.walmartimages.com/asr/025a7068-7bb1...	5

In [33]:

```
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_c
```

In [34]:

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

In [35]:

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

In [36]:

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

```
recommended_items_indices = [x[0] for x in top_similar_items]
```

```
In [37]: train_data.iloc[recommended_items_indices][['Name', 'ReviewCount', 'Brand']]
```

Out[37]:

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

```
In [38]: 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']]

    return recommended_items_details
```

```
In [39]: # 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
```

Out[39]:

		Name	ReviewCount	Brand	ImageURL	Rating
156	OPI Nail Lacquer Polish .5oz/15mL - This Gown ...		0.0	opi	https://i5.walmartimages.com/asr/71caed3f-5f83...	0.0
184	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...		0.0	opi	https://i5.walmartimages.com/asr/2d6f5147-53a8...	0.0
205	OPI Nail Lacquer - Dont Bossa Nova Me Around -...		0.0	opi	https://i5.walmartimages.com/asr/fd1195d2-8d8d...	0.0
237	OPI Infinite Shine 2 Polish - ISL P33 - Alpaca...		5.0	opi	https://i5.walmartimages.com/asr/7426eb5c-1690...	0.0
325	OPI Gel Polish Fall 2019 Scotland Collection G...		1.0	opi	https://i5.walmartimages.com/asr/79bbb9f-9a89...	0.0
375	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...		1.0	opi	https://i5.walmartimages.com/asr/744e869c-3500...	5.0
402	OPI Nail Polish, Strawberry Margarita, 0.5 Fl Oz		57.0	opi	https://i5.walmartimages.com/asr/b95676e5-96ab...	4.4
706	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...		1.0	opi	https://i5.walmartimages.com/asr/c7ba4815-52f7...	5.0

In [40]:

```
# 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
```

Out[40]:

	Name	ReviewCount	Brand	ImageURL	Rating
3406	Kokie Professional Matte Lipstick, Firecracker...	0.0	kokie, cosmetics	https://i5.walmartimages.com/asr/8312221bed22...	0.0
546	Kokie Professional Matte Lipstick, Kiss Me, 0....	0.0	kokie, cosmetics	https://i5.walmartimages.com/asr/27dd82a2-2b9c...	0.0
2406	L.A. Colors Matte Lipstick, Tender Matte	3.0	colors	https://i5.walmartimages.com/asr/271264fb-e8c3...	3.7
4050	Kokie Professional Lip Poudre Liquid Matte Liq...	7.0	kokie, cosmetics	https://i5.walmartimages.com/asr/fdd7498c-319f...	3.4
4084	e.l.f. Mad for Matte 4 Piece Lip Color Set	0.0	cosmetics	https://i5.walmartimages.com/asr/e2d30304-edc9...	0.0
1559	LOreal Paris Colour Riche Matte Lip Liner, Mat...	495.0	paris	https://i5.walmartimages.com/asr/baf97085-7231...	4.4
2873	Kokie Professional Lip Poudre Liquid Matte Liq...	7.0	kokie, cosmetics	https://i5.walmartimages.com/asr/31c99d9b-ea11...	3.4
3023	Be Matte Lipstick - Pink	2.0	city, color	https://i5.walmartimages.com/asr/4425a13e-085f...	3.0

In [41]: user_item_matrix = train_data.pivot_table(index='ID', columns='ProdID', values='Rat

In [42]: user_similarity = cosine_similarity(user_item_matrix)

In [43]: target_user_id = 4
target_user_index = user_item_matrix.index.get_loc(target_user_id)In [44]: user_similarities = user_similarity[target_user_index]

similar_user_indices = user_similarities.argsort()[:-1][1:]In [45]: 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[

```
In [46]: recommended_items_details.head(10)
```

Out[46]:

	Name	ReviewCount	Brand	ImageURL	Rating
15	Clairol Natural Instincts Demi-Permanent Hair ...	2935.0	clairol	https://i5.walmartimages.com/asr/00a6e54ae431...	3.7
33	DenTek Kids Fun Flossers, Removes Food & Plaque...	3.0	dentek	https://i5.walmartimages.com/asr/de6e52eb-6e18...	0.0
61	COVERGIRL Exhibitionist Cream Lipstick, 395 Da...	713.0	covergirl	https://i5.walmartimages.com/asr/95076ec0-ffbd...	4.3
64	Neutrogena SkinClearing Oil-Free Liquid Founda...	741.0	neutrogena	https://i5.walmartimages.com/asr/fd4d78d8-310a...	4.2
69	Design Essentials Natural Coconut & Monoi Curl...	1.0	design, essentials	https://i5.walmartimages.com/asr/ff2dba1d-0c02...	5.0
78	Paul Sebastian Fine Cologne Spray, Cologne for...	28.0	paul, sebastian	https://i5.walmartimages.com/asr/03d08a07-18d7...	4.8
85	BioAstin Hawaiian Astaxanthin, Vegan, 12mg, 75 Ct	3.0	bioastin	https://i5.walmartimages.com/asr/6da9e238-b19e...	5.0
92	Bytewise Organic Moringa Leaf Powder, 12 Oz	0.0	bytewise	https://i5.walmartimages.com/asr/076f2b3fdcc3...	0.0
94	Ag Hair Cosmetics Ultradynamics Extra-Firm Fin...	0.0	ag, hair	https://i5.walmartimages.com/asr/5d217d98-a385...	0.0
108	OPI Nail Dipping Powder Perfection Combo - Liq...	1.0	opi	https://i5.walmartimages.com/asr/ef1607ee-5bdb...	3.0

```
In [47]: 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='

        # 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

                # Extract the item IDs of recommended items
                recommended_items.extend(user_item_matrix.columns[not_rated_by_target_user])

            # Get the details of recommended items
            recommended_items_details = train_data[train_data['ProdID'].isin(recommended_it

        return recommended_items_details.head(10)

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

Top 5 recommendations for User 4:

Out[47]:

	Name	ReviewCount	Brand	ImageURL	Rating
61	COVERGIRL Exhibitionist Cream Lipstick, 395 Da...	713.0	covergirl	https://i5.walmartimages.com/asr/95076ec0-ffbd...	4.3
85	BioAstin Hawaiian Astaxanthin, Vegan, 12mg, 75 Ct	3.0	bioastin	https://i5.walmartimages.com/asr/6da9e238-b19e...	5.0
86	LOreal Paris Feria Multi-Faceted Shimmering Pe...	2144.0	paris	https://i5.walmartimages.com/asr/c229026a-2b75...	3.1
108	OPI Nail Dipping Powder Perfection Combo - Liq...	1.0	opi	https://i5.walmartimages.com/asr/ef1607ee-5bdb...	3.0
144	Covidien Curity Maternity Pad Heavy 4.33" ...	0.0	covidien	https://i5.walmartimages.com/asr/e4e38217-ed43...	0.0
155	Crest 3D White Brilliance Mouthwash, Alcohol F...	63.0	crest	https://i5.walmartimages.com/asr/1fcc5525-9ae3...	0.0
174	COVERGIRL Outlast All-Day Moisturizing Lip Col...	36.0	covergirl	https://i5.walmartimages.com/asr/4479896f-c6c4...	0.0
193	Revlon ColorStay Skinny Liquid Liner, 304 Gree...	70.0	revlon	https://i5.walmartimages.com/asr/aa3b20a6-3d6d...	4.5
212	Comvita Certified UMF 20+ Manuka Honey, Raw & ...	0.0	comvita	https://i5.walmartimages.com/asr/3cdc1498-a2ac...	0.0
241	Ahava Mens Mineral Hand Cream, 3.4 Oz	0.0	ahava	https://i5.walmartimages.com/asr/f74e4bb7-47d3...	0.0

In [48]:

```
# 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_dat

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

```
return hybrid_rec.head(10)
```

```
In [49]: # 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" #
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':

Out[49]:

		Name	ReviewCount	Brand	ImageURL	Rating
156	OPI Nail Lacquer Polish .5oz/15mL - This Gown ...		0.0	opi	https://i5.walmartimages.com/asr/71caed3f-5f83...	0.0
184	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...		0.0	opi	https://i5.walmartimages.com/asr/2d6f5147-53a8...	0.0
205	OPI Nail Lacquer - Dont Bossa Nova Me Around -...		0.0	opi	https://i5.walmartimages.com/asr/fd1195d2-8d8d...	0.0
237	OPI Infinite Shine 2 Polish - ISL P33 - Alpaca...		5.0	opi	https://i5.walmartimages.com/asr/7426eb5c-1690...	0.0
325	OPI Gel Polish Fall 2019 Scotland Collection G...		1.0	opi	https://i5.walmartimages.com/asr/79bbbd9f-9a89...	0.0
375	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...		1.0	opi	https://i5.walmartimages.com/asr/744e869c-3500...	5.0
402	OPI Nail Polish, Strawberry Margarita, 0.5 Fl Oz		57.0	opi	https://i5.walmartimages.com/asr/b95676e5-96ab...	4.4
706	OPI Nail Gel Polish GelColor .5oz/15mL 3 CT Co...		1.0	opi	https://i5.walmartimages.com/asr/c7ba4815-52f7...	5.0
886	OPI- Nail Lacquer-GelColor - "Liv"in t...		0.0	opi	https://i5.walmartimages.com/asr/98b4194c-e026...	0.0
1042	OPI GelColor Gel Nail Polish, Dulce De Leche, ...		1.0	opi	https://i5.walmartimages.com/asr/c1b2c370-b2d2...	0.0

In [50]:

```
# 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':

Out[50]:

		Name	ReviewCount	Brand	ImageURL	Rating
896		Black Radiance Perfect Tone Lip Color, Vintage...	78.0	black, radiance	https://i5.walmartimages.com/asr/485f26b4-a19a...	4.7
2496		Black Radiance Perfect Tone Lip Color, Hollywo...	18.0	black, radiance	https://i5.walmartimages.com/asr/fe3da48f-5142...	4.3
3		Kokie Professional Matte Lipstick, Hot Berry, ...	0.0	kokie, cosmetics	https://i5.walmartimages.com/asr/25b4b467-bc61...	0.0
3406		Kokie Professional Matte Lipstick, Firecracker...	0.0	kokie, cosmetics	https://i5.walmartimages.com/asr/8312221b-ed22...	0.0
2406		L.A. Colors Matte Lipstick, Tender Matte	3.0	colors	https://i5.walmartimages.com/asr/271264fb-e8c3...	3.7
4050		Kokie Professional Lip Poudre Liquid Matte Liq...	7.0	kokie, cosmetics	https://i5.walmartimages.com/asr/fdd7498c-319f...	3.4
2873		Kokie Professional Lip Poudre Liquid Matte Liq...	7.0	kokie, cosmetics	https://i5.walmartimages.com/asr/31c99d9b-ea11...	3.4
4872		L.A. Colors Matte Lipstick, Torrid Matte	8.0	colors	https://i5.walmartimages.com/asr/62d6d9fa-eee1...	4.8
1300		e.l.f. Liquid Matte Lipstick, Tea Rose	476.0	cosmetics	https://i5.walmartimages.com/asr/58220de4-3875...	4.1
420		Black Opal Color Splurge Sassy Luxe Matte Lips...	0.0	black, opal	https://i5.walmartimages.com/asr/a991241b-e4ad...	0.0

