Data Science Major Project:

Online Retail Recommendation System:

If you have tried online shopping, you must have noticed that when you are checking out a product on an e-Commerce site, there is a list of suggested products that you are presented with. In this project, you will develop a recommendation system.

For this, we are attaching a dataset containing information about recommendation systems for online retail data, so that we can understand what type of product can be recommended.

We are providing a dataset from Kaggle, which contains historical information about online retail data which can be usedto detect which product is highly recommended. Below are all
the columns from the dataset we are using here

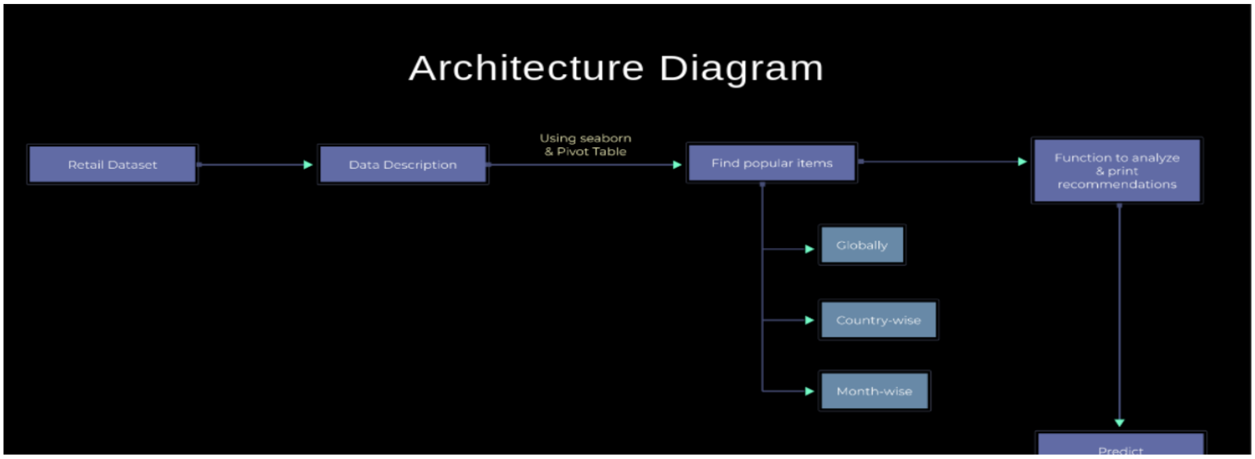
Invoice Number: This is the number that identifies a transaction.Stock Code: This refers to the product ID.
Description: This describes the product that a user purchased.Quantity: It specified the quantity of the item purchased.
Invoice Date: The date on which the transaction took place.Unit Price: Price of one product.
Customer ID: It identifies the customer.

Country: The country where the transaction was performed.

Language Used: Python

Dataset is attached in the project email as csv format. Develop a Recommendation System using the data set.

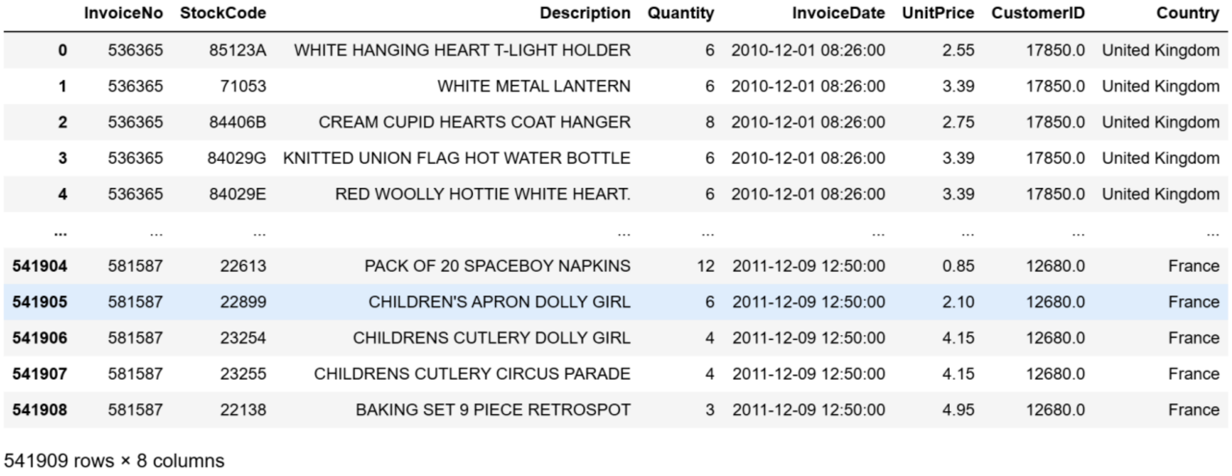
Architecture:



Code of the project:

```
import pandas as pd

import numpy as np

from sklearn.model_selection import train_test_split

from sklearn.metrics.pairwise import cosine_similarity

from sklearn.decomposition import NMF

import seaborn as sns

import matplotlib.pyplot as plt

from sklearn.metrics.pairwise import cosine_similarity

pip install openpyxl

#read the excel

df = pd.read_excel(r"C:\Users\vardh\OneDrive\Desktop\IntrainZ\OnlineRetail (1).xlsx")

df
```

#output:

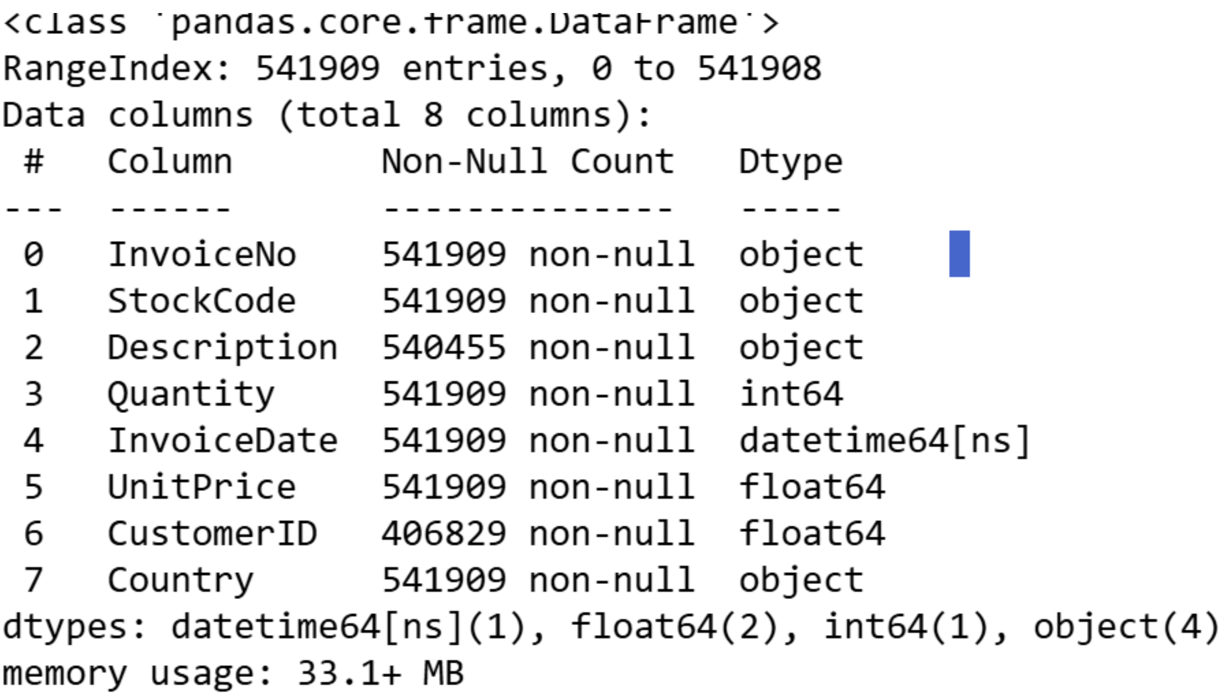


	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	2010-12-01 08:26:00	2.55	17850.0	United Kingdom
1	536365	71053	WHITE METAL LANTERN	6	2010-12-01 08:26:00	3.39	17850.0	United Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	2010-12-01 08:26:00	2.75	17850.0	United Kingdom
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	2010-12-01 08:26:00	3.39	17850.0	United Kingdom
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	2010-12-01 08:26:00	3.39	17850.0	United Kingdom
...	...	...	...	...	...	...	...	...
541904	581587	22613	PACK OF 20 SPACEBOY NAPKINS	12	2011-12-09 12:50:00	0.85	12680.0	France
541905	581587	22899	CHILDREN'S APRON DOLLY GIRL	6	2011-12-09 12:50:00	2.10	12680.0	France
541906	581587	23254	CHILDRENS CUTLERY DOLLY GIRL	4	2011-12-09 12:50:00	4.15	12680.0	France
541907	581587	23255	CHILDRENS CUTLERY CIRCUS PARADE	4	2011-12-09 12:50:00	4.15	12680.0	France
541908	581587	22138	BAKING SET 9 PIECE RETROSPOT	3	2011-12-09 12:50:00	4.95	12680.0	France

541909 rows × 8 columns

#INFO

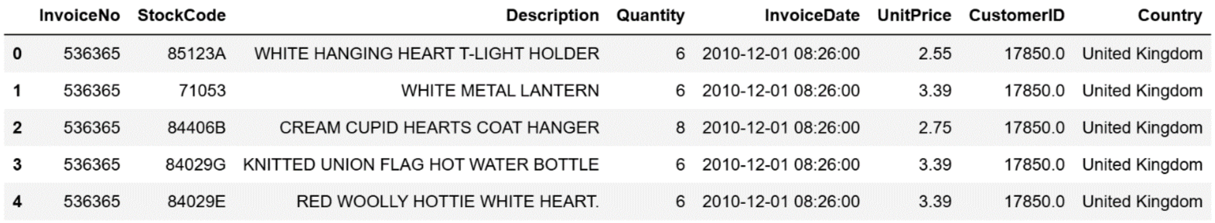
df.info()



```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 541909 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   InvoiceNo    541909 non-null  object
 1   StockCode    541909 non-null  object
 2   Description  540455 non-null  object
 3   Quantity     541909 non-null  int64
 4   InvoiceDate  541909 non-null  datetime64[ns]
 5   UnitPrice    541909 non-null  float64
 6   CustomerID   406829 non-null  float64
 7   Country      541909 non-null  object
dtypes: datetime64[ns](1), float64(2), int64(1), object(4)
memory usage: 33.1+ MB
```

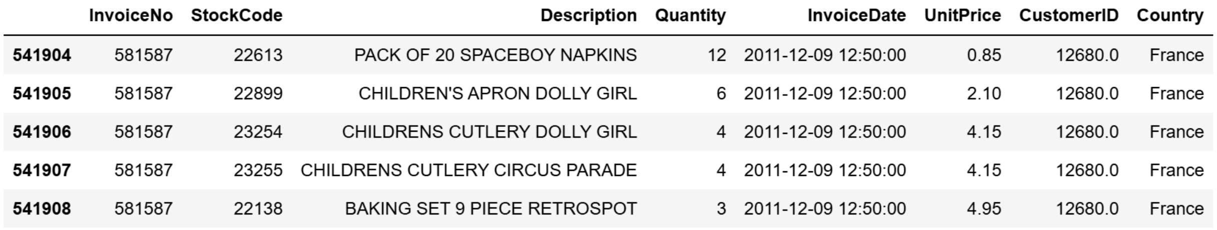
#HEAD AND TAIL OF THE DATA SET

df.head()



	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	2010-12-01 08:26:00	2.55	17850.0	United Kingdom
1	536365	71053	WHITE METAL LANTERN	6	2010-12-01 08:26:00	3.39	17850.0	United Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	2010-12-01 08:26:00	2.75	17850.0	United Kingdom
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	2010-12-01 08:26:00	3.39	17850.0	United Kingdom
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	2010-12-01 08:26:00	3.39	17850.0	United Kingdom

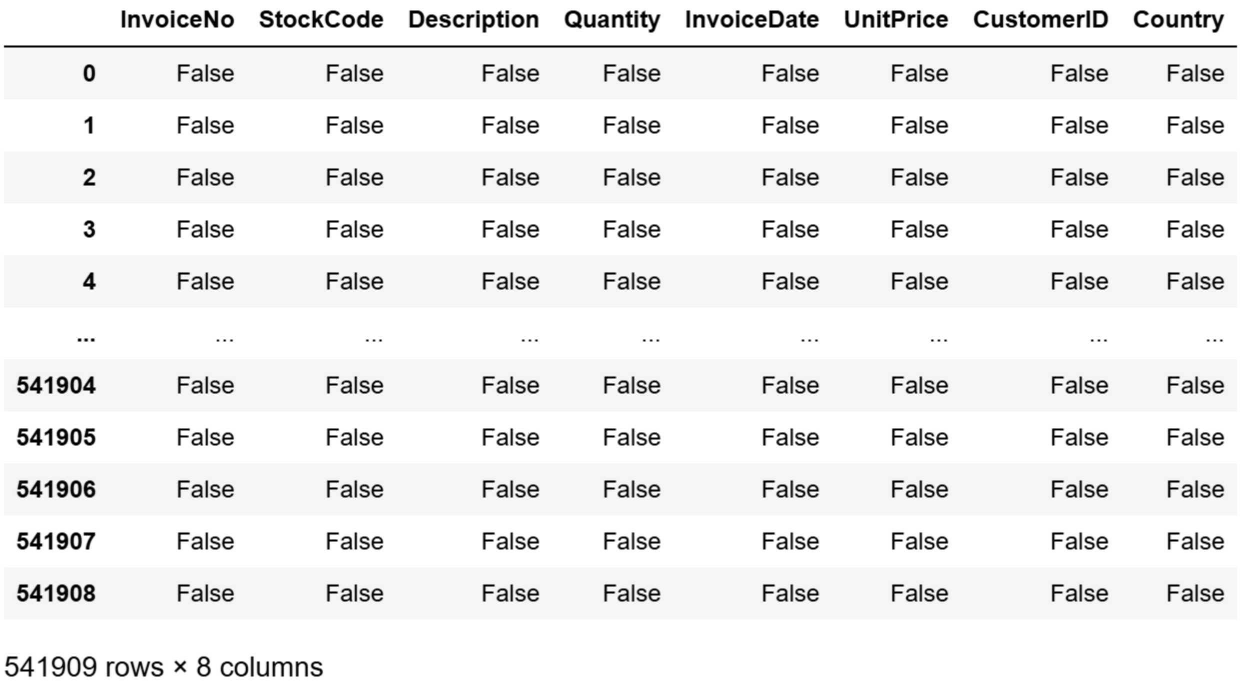
df.tail()



	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
541904	581587	22613	PACK OF 20 SPACEBOY NAPKINS	12	2011-12-09 12:50:00	0.85	12680.0	France
541905	581587	22899	CHILDREN'S APRON DOLLY GIRL	6	2011-12-09 12:50:00	2.10	12680.0	France
541906	581587	23254	CHILDRENS CUTLERY DOLLY GIRL	4	2011-12-09 12:50:00	4.15	12680.0	France
541907	581587	23255	CHILDRENS CUTLERY CIRCUS PARADE	4	2011-12-09 12:50:00	4.15	12680.0	France
541908	581587	22138	BAKING SET 9 PIECE RETROSPOT	3	2011-12-09 12:50:00	4.95	12680.0	France

#CHECKING NULL VALUES OF THE DATA SET

df.isnull()



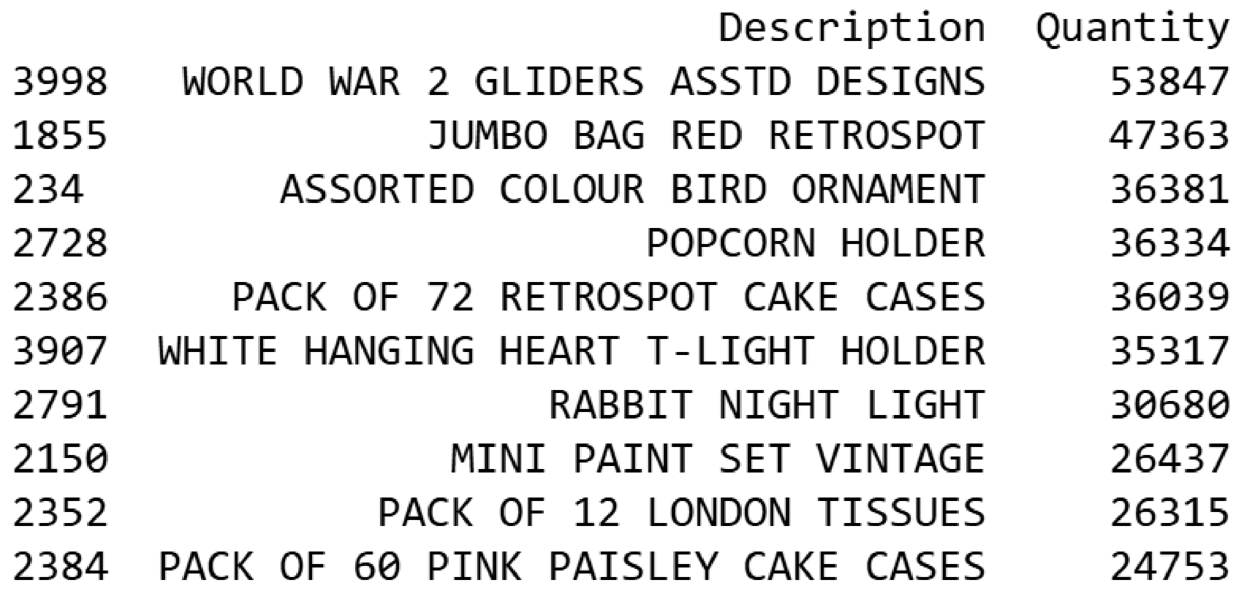
	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	False	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False
...	...	...	...	...	...	...	...	...
541904	False	False	False	False	False	False	False	False
541905	False	False	False	False	False	False	False	False
541906	False	False	False	False	False	False	False	False
541907	False	False	False	False	False	False	False	False
541908	False	False	False	False	False	False	False	False

541909 rows × 8 columns

#Top 10 Selling Products by Quantity:

```
import pandas as pd

top_products = df.pivot_table(index='Description', values='Quantity',
aggfunc='sum').reset_index()

top_products = top_products.nlargest(10, 'Quantity')

print(top_products)
```

OUTPUT:

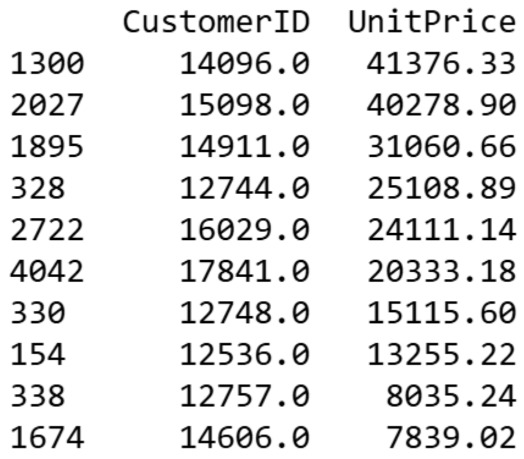


```
                             Description  Quantity
3998   WORLD WAR 2 GLIDERS ASSTD DESIGNS     53847
1855             JUMBO BAG RED RETROSPOT     47363
234        ASSORTED COLOUR BIRD ORNAMENT     36381
2728                      POPCORN HOLDER     36334
2386     PACK OF 72 RETROSPOT CAKE CASES     36039
3907  WHITE HANGING HEART T-LIGHT HOLDER     35317
2791                 RABBIT NIGHT LIGHT      30680
2150             MINI PAINT SET VINTAGE      26437
2352          PACK OF 12 LONDON TISSUES      26315
2384  PACK OF 60 PINK PAISLEY CAKE CASES     24753
```

#Top 10 Customers by Total Spend:

```
top_customers = df.pivot_table(index='CustomerID', values='UnitPrice',
aggfunc='sum').reset_index()

top_customers = top_customers.nlargest(10, 'UnitPrice')

print(top_customers)
```

OUTPUT:

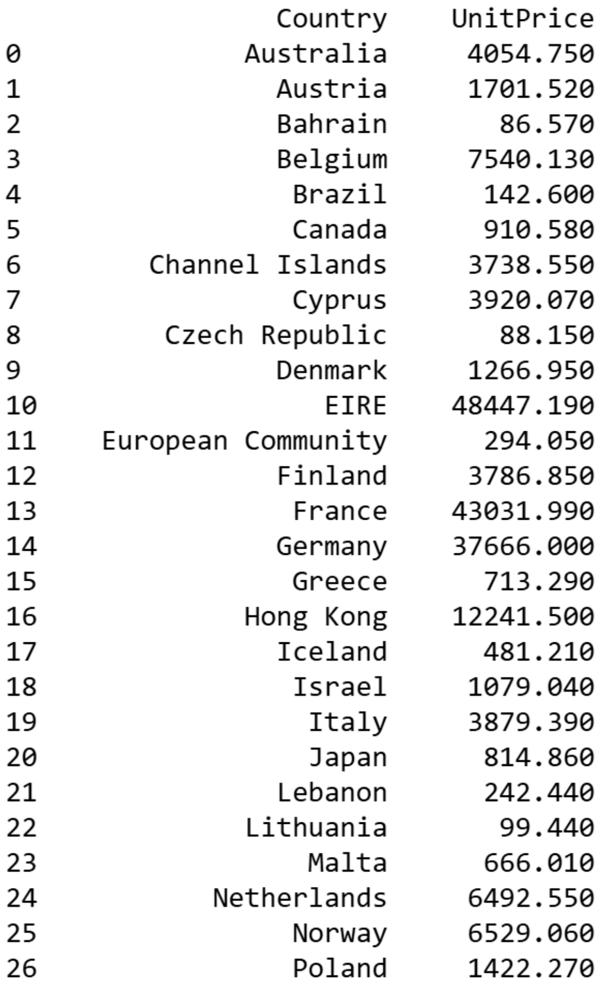


```
      CustomerID  UnitPrice
1300     14096.0   41376.33
2027     15098.0   40278.90
1895     14911.0   31060.66
328      12744.0   25108.89
2722     16029.0   24111.14
4042     17841.0   20333.18
330      12748.0   15115.60
154      12536.0   13255.22
338      12757.0    8035.24
1674     14606.0    7839.02
```

#Country-wise Sales:

country_sales = df.pivot_table(index='Country', values='UnitPrice', aggfunc='sum').reset_index()

print(country_sales)



```
                Country   UnitPrice
0             Australia    4054.750
1               Austria    1701.520
2               Bahrain      86.570
3               Belgium    7540.130
4                Brazil     142.600
5                Canada     910.580
6       Channel Islands    3738.550
7                Cyprus    3920.070
8        Czech Republic      88.150
9               Denmark    1266.950
10                 EIRE   48447.190
11   European Community     294.050
12              Finland    3786.850
13               France   43031.990
14              Germany   37666.000
15               Greece     713.290
16            Hong Kong   12241.500
17              Iceland     481.210
18               Israel    1079.040
19                Italy    3879.390
20                Japan     814.860
21              Lebanon     242.440
22            Lithuania      99.440
23                Malta     666.010
24          Netherlands    6492.550
25               Norway    6529.060
26               Poland    1422.270
```

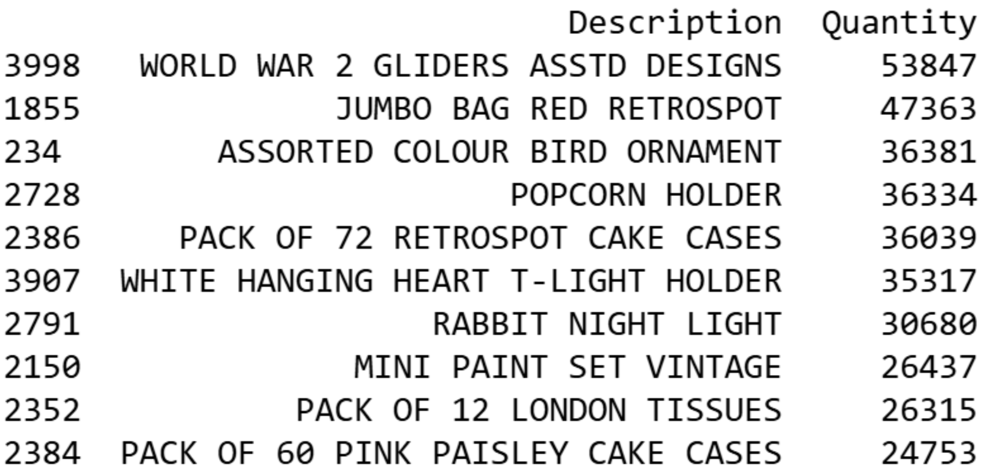
#Globally Popular Items:

global_popular_items = df.pivot_table(index='Description', values='Quantity', aggfunc='sum').reset_index()

global_popular_items = global_popular_items.nlargest(10, 'Quantity')

print(global_popular_items)

OUTPUT:



```
                              Description  Quantity
3998   WORLD WAR 2 GLIDERS ASSTD DESIGNS     53847
1855             JUMBO BAG RED RETROSPOT     47363
234        ASSORTED COLOUR BIRD ORNAMENT     36381
2728                      POPCORN HOLDER     36334
2386     PACK OF 72 RETROSPOT CAKE CASES     36039
3907  WHITE HANGING HEART T-LIGHT HOLDER     35317
2791                  RABBIT NIGHT LIGHT     30680
2150             MINI PAINT SET VINTAGE      26437
2352          PACK OF 12 LONDON TISSUES      26315
2384  PACK OF 60 PINK PAISLEY CAKE CASES     24753
```

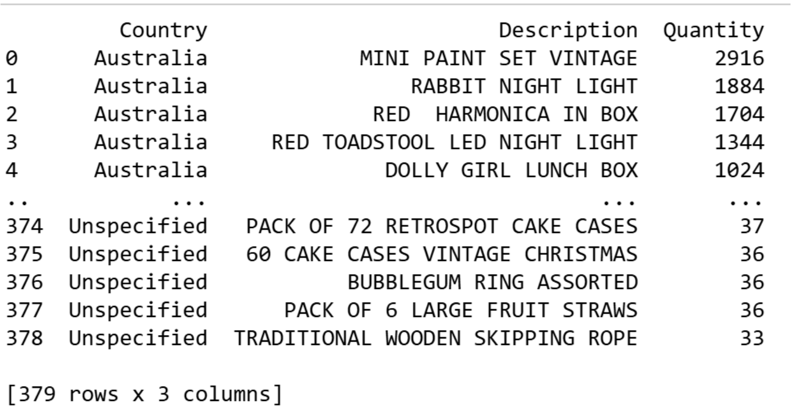
#Country-wise Popular Items:

country_popular_items = df.pivot_table(index=['Country', 'Description'], values='Quantity', aggfunc='sum').reset_index()

country_popular_items = country_popular_items.groupby('Country').apply(lambda x: x.nlargest(10, 'Quantity')).reset_index(drop=True)

print(country_popular_items)

OUTPUT:

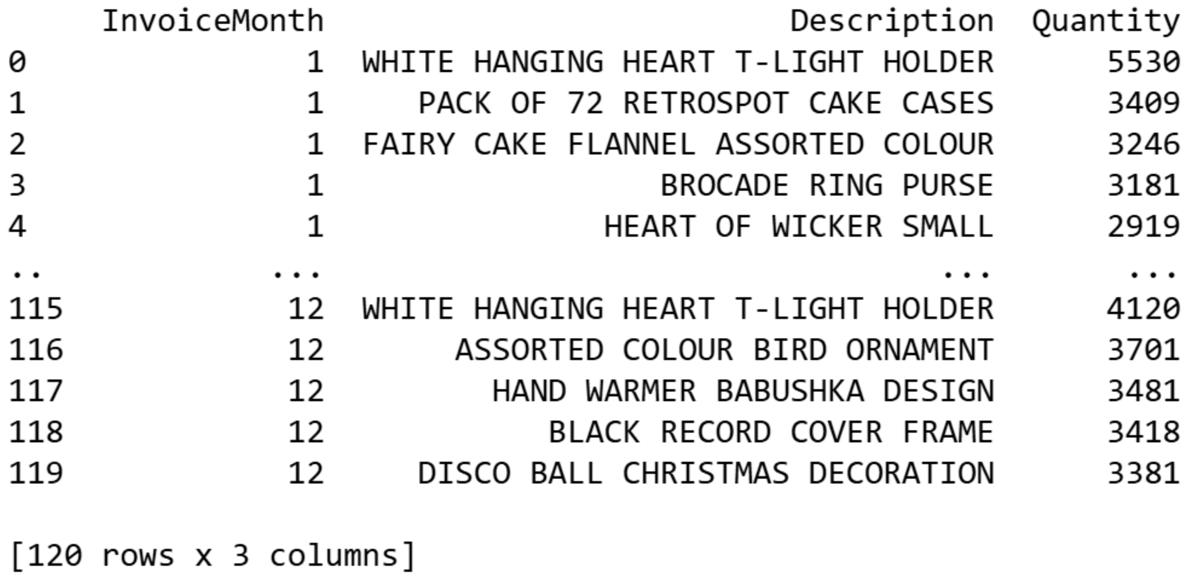


```
         Country                         Description  Quantity
0      Australia              MINI PAINT SET VINTAGE      2916
1      Australia                  RABBIT NIGHT LIGHT      1884
2      Australia                RED  HARMONICA IN BOX      1704
3      Australia       RED TOADSTOOL LED NIGHT LIGHT      1344
4      Australia                DOLLY GIRL LUNCH BOX      1024
..           ...                                 ...       ...
374  Unspecified   PACK OF 72 RETROSPOT CAKE CASES        37
375  Unspecified   60 CAKE CASES VINTAGE CHRISTMAS        36
376  Unspecified          BUBBLEGUM RING ASSORTED         36
377  Unspecified      PACK OF 6 LARGE FRUIT STRAWS        36
378  Unspecified  TRADITIONAL WOODEN SKIPPING ROPE        33

[379 rows x 3 columns]
```

#Monthly Popular Items:

```
df['InvoiceMonth'] = df['InvoiceDate'].dt.month

monthly_popular_items = df.pivot_table(index=['InvoiceMonth', 'Description'],
values='Quantity', aggfunc='sum').reset_index()

monthly_popular_items = monthly_popular_items.groupby('InvoiceMonth').apply(lambda x:
x.nlargest(10, 'Quantity')).reset_index(drop=True)

print(monthly_popular_items)
```

OUTPUT:



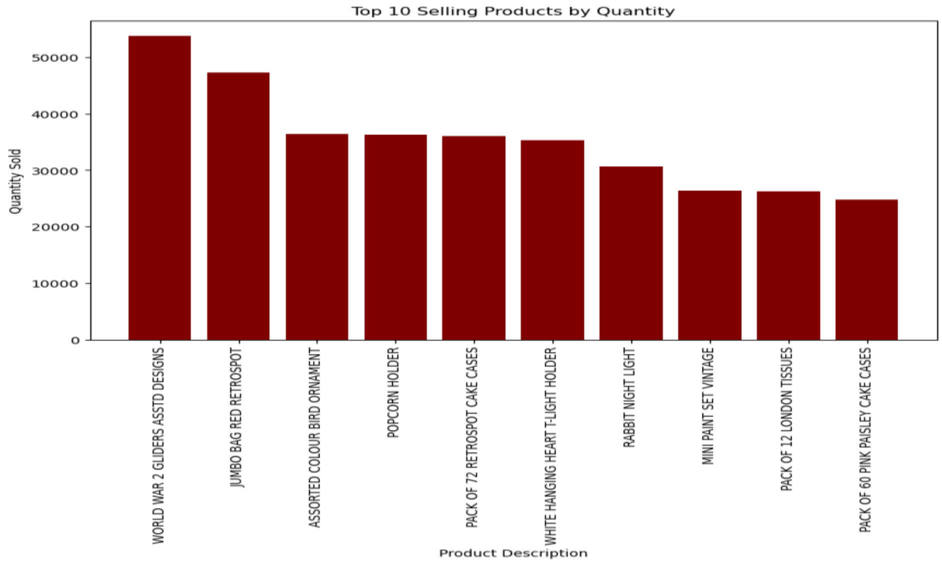
```
     InvoiceMonth                         Description  Quantity
0               1  WHITE HANGING HEART T-LIGHT HOLDER      5530
1               1     PACK OF 72 RETROSPOT CAKE CASES      3409
2               1  FAIRY CAKE FLANNEL ASSORTED COLOUR      3246
3               1                 BROCADE RING PURSE      3181
4               1              HEART OF WICKER SMALL      2919
..            ...                                 ...       ...
115            12  WHITE HANGING HEART T-LIGHT HOLDER      4120
116            12       ASSORTED COLOUR BIRD ORNAMENT      3701
117            12         HAND WARMER BABUSHKA DESIGN      3481
118            12            BLACK RECORD COVER FRAME      3418
119            12     DISCO BALL CHRISTMAS DECORATION      3381

[120 rows x 3 columns]
```

VISUALIZATION:

#Top 10 Selling Products by Quantity:

```
plt.figure(figsize=(10,6))

plt.bar(top_products['Description'], top_products['Quantity'], color ='maroon')

plt.xlabel("Product Description")

plt.ylabel("Quantity Sold")

plt.title("Top 10 Selling Products by Quantity")
plt.xticks(rotation=90)

plt.show()
```

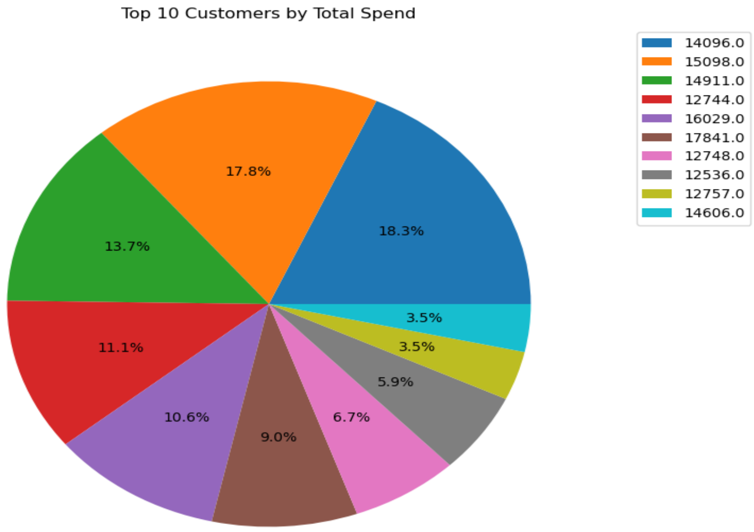
OUTPUT:



#Top 10 Customers by Total Spend:

```
plt.figure(figsize=(10,8))

plt.pie(top_customers['UnitPrice'], autopct='%1.1f%%')

plt.title('Top 10 Customers by Total Spend')

plt.legend(top_customers['CustomerID'], bbox_to_anchor=(1.05, 1), loc='upper left')

plt.show()
```

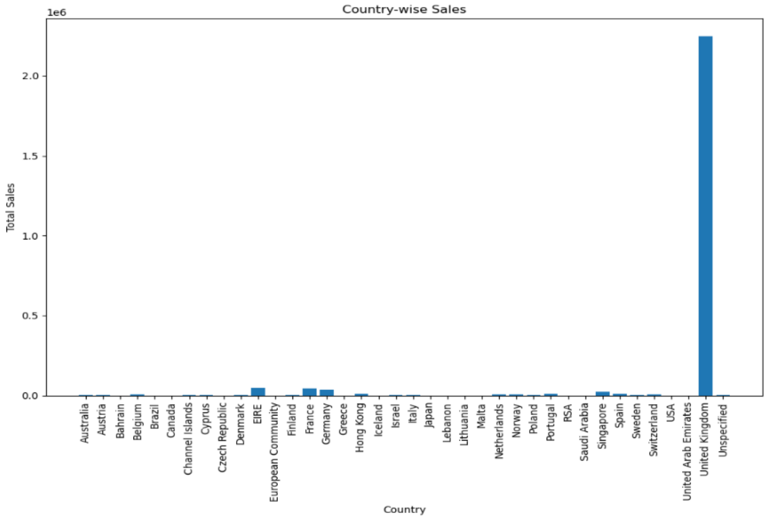
OUTPUT:



#Country-wise Sales:

```
plt.figure(figsize=(10,8))

plt.bar(country_sales['Country'], country_sales['UnitPrice'])

plt.xlabel('Country')

plt.ylabel('Total Sales')

plt.title('Country-wise Sales')

plt.xticks(rotation=90)

plt.tight_layout()

plt.show()
```

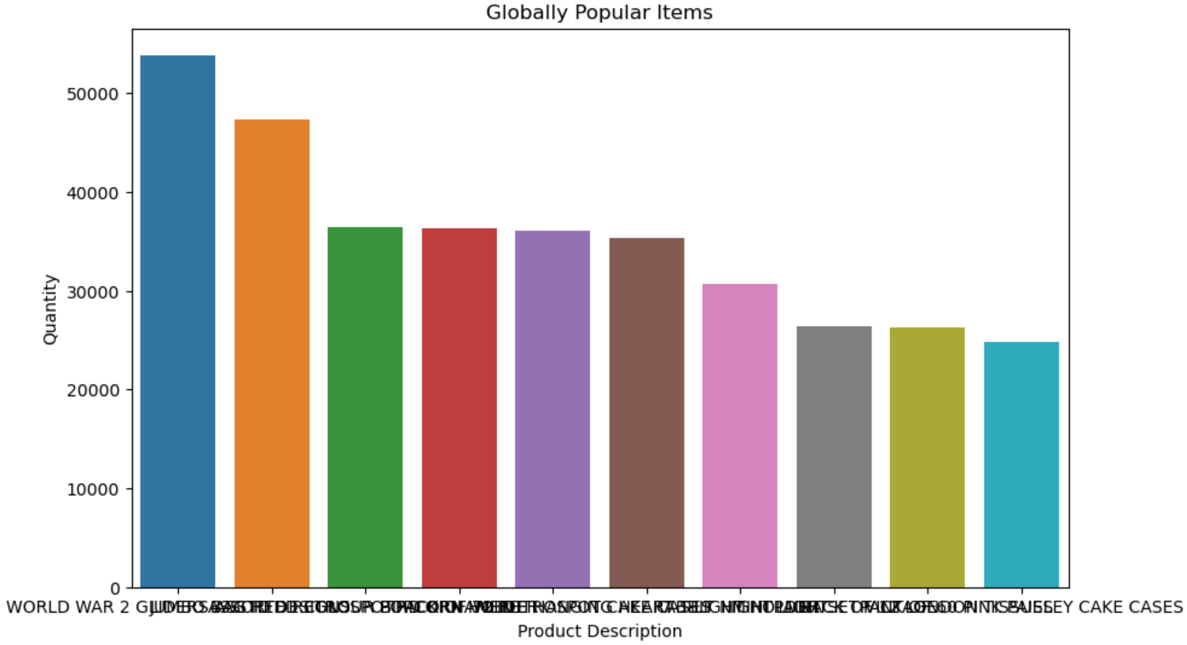
OUTPUT:



#Globally Popular Items

```
plt.figure(figsize=(10, 6))

sns.barplot(x='Description', y='Quantity', data=global_popular_items)

plt.title('Globally Popular Items')

plt.xlabel('Product Description')

plt.ylabel('Quantity')

plt.show()
```

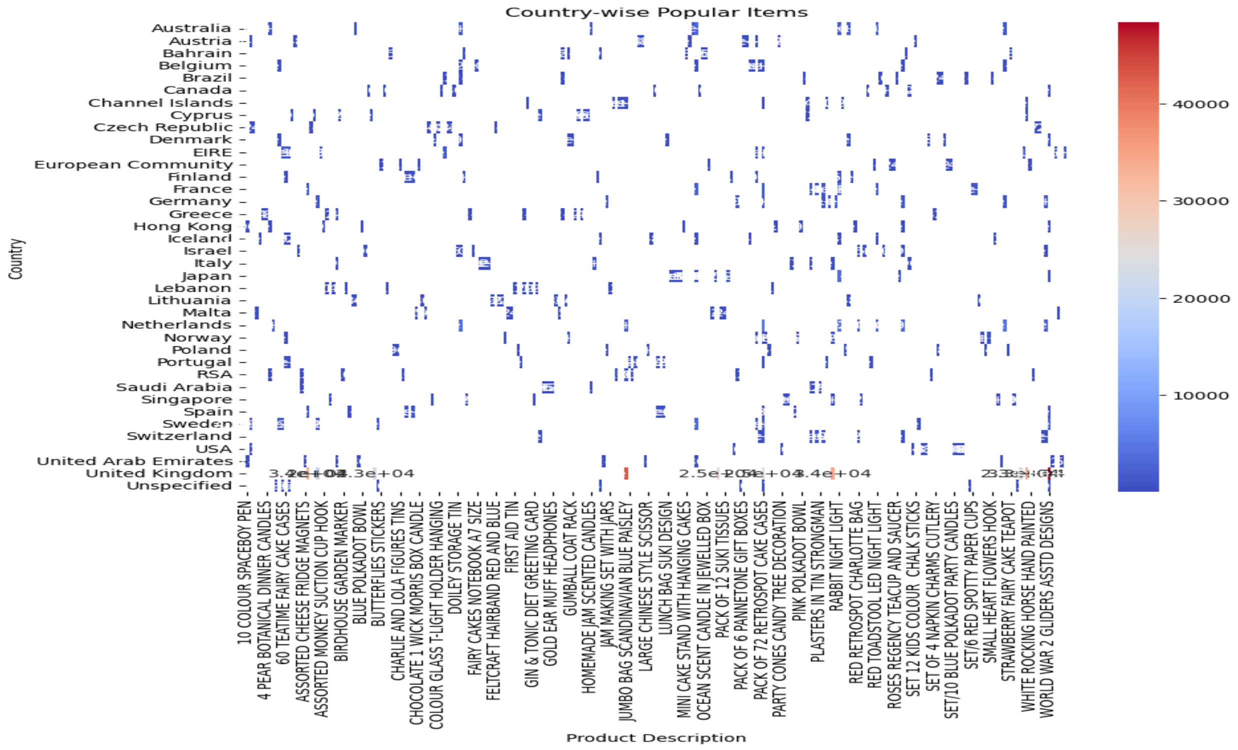
OUTPUT:



#Country-wise Popular Items:

```
plt.figure(figsize=(10, 8))

sns.heatmap(country_popular_items.pivot(index='Country', columns='Description', values='Quantity'), annot=True, cmap='coolwarm')

plt.title('Country-wise Popular Items')

plt.xlabel('Product Description')

plt.ylabel('Country')

plt.show()
```

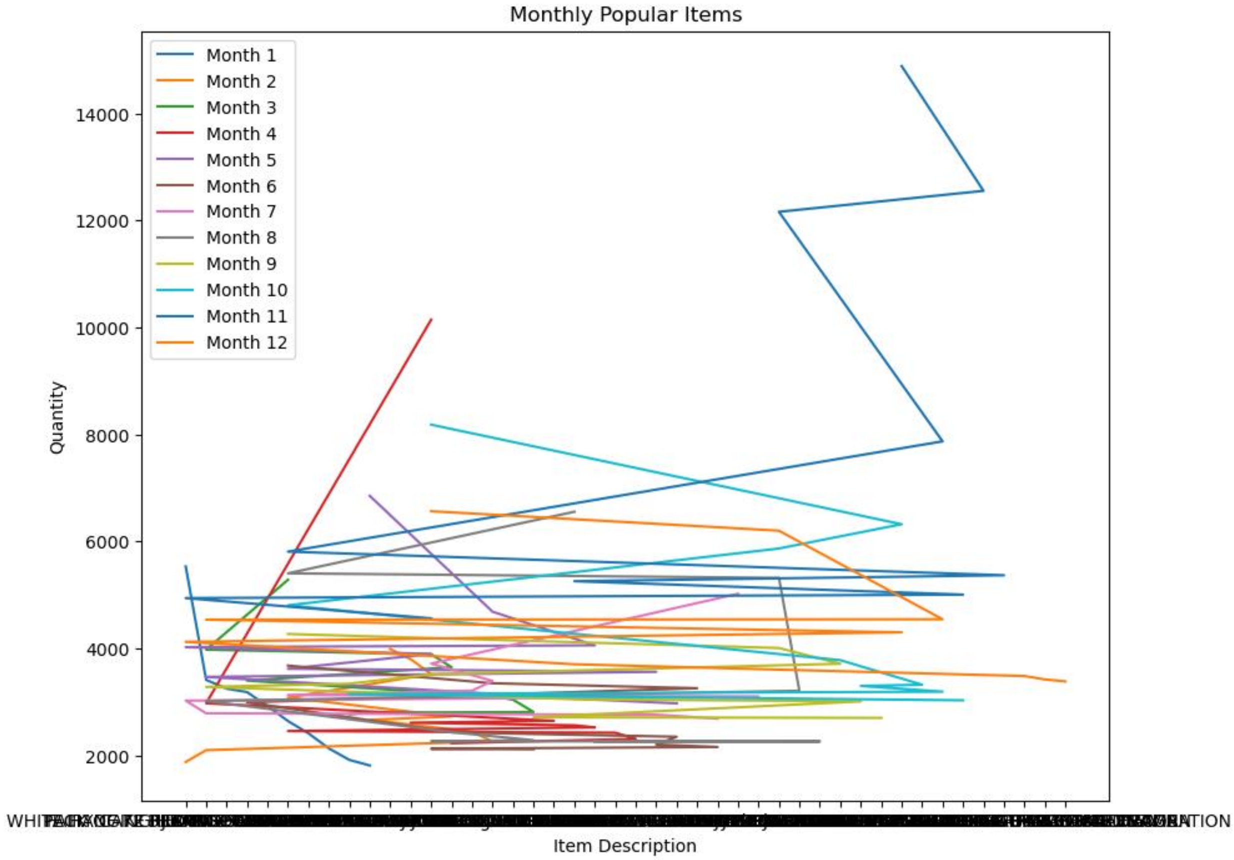
OUTPUT:



#Monthly Popular Items:

```
plt.figure(figsize=(10,8))

for month in monthly_popular_items['InvoiceMonth'].unique():

    month_data = monthly_popular_items[monthly_popular_items['InvoiceMonth'] == month]

    plt.plot(month_data['Description'], month_data['Quantity'], label=f'Month {month}')
plt.xlabel('Item Description')

plt.ylabel('Quantity')

plt.title('Monthly Popular Items')

plt.legend()

plt.show()
```

OUTPUT:

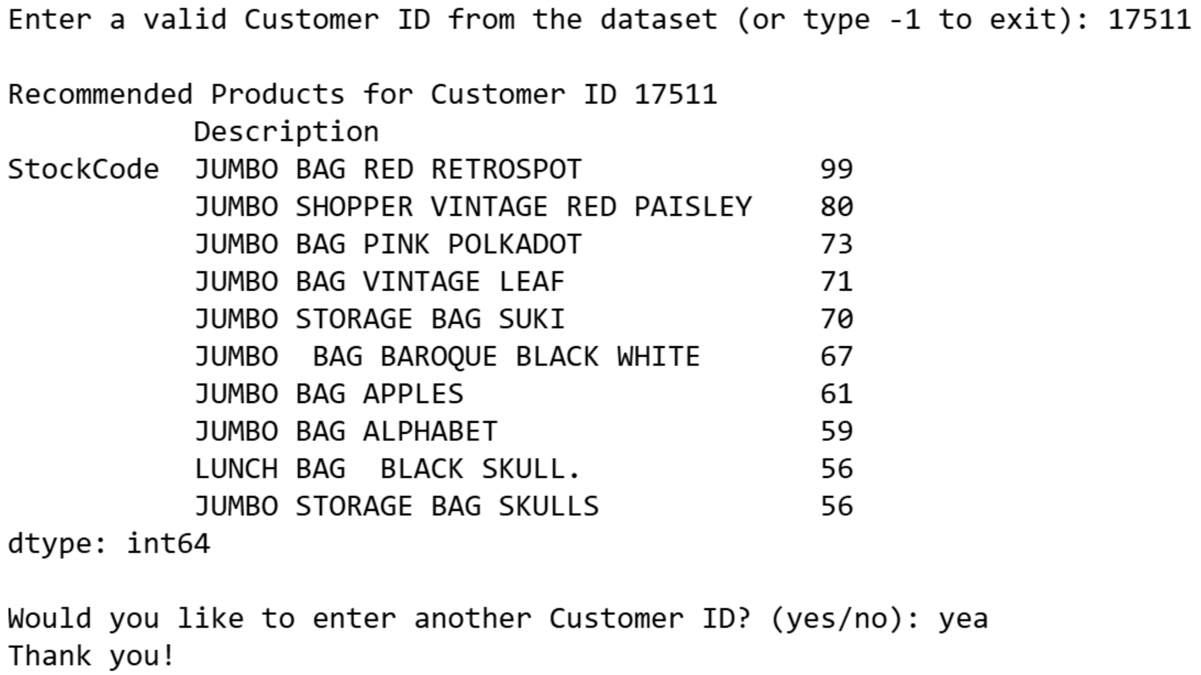


RECOMMENDER SYSTEM FOR ONLINE RETAIL SYSTEM:

```
df = df[['CustomerID', 'StockCode', 'Description']]

df = df.dropna()

df['CustomerID'] = df['CustomerID'].astype(int)

df['StockCode'] = df['StockCode'].astype(str)

matrix = df.pivot_table(index='CustomerID', columns='Description', aggfunc=len, fill_value=0)

cosine_sim = cosine_similarity(matrix)
```

```
def get_product_recommendations(customer_id, cosine_sim=cosine_sim, matrix=matrix):
    idx = matrix.index.get_loc(customer_id)
    sim_scores = list(enumerate(cosine_sim[idx]))
    sim_scores = sorted(sim_scores, key=lambda x: x[1], reverse=True)
    sim_scores = sim_scores[1:11]
    customer_indices = [i[0] for i in sim_scores]
    recommendations = matrix.iloc[customer_indices,
:].sum().sort_values(ascending=False).head(10)
    return recommendations
while True:
    try:
        customer_id = int(input("Enter a valid Customer ID from the dataset (or type -1 to exit): "))
        if customer_id == -1:
            print("Exiting the recommendation system.")
            break

        recommended_products = get_product_recommendations(customer_id)
        print("\nRecommended Products for Customer ID", customer_id)
        print(recommended_products)

        continue_choice = input("\nWould you like to enter another Customer ID? (yes/no):
").strip().lower()
        if continue_choice != 'yes':
            print("Thank you!")
            break

    except Exception as e:
        print(f"An error occurred: {e}. Please try again with a valid Customer ID.")
```

OUTPUT:



```
Enter a valid Customer ID from the dataset (or type -1 to exit): 17511

Recommended Products for Customer ID 17511
           Description
StockCode  JUMBO BAG RED RETROSPOT             99
           JUMBO SHOPPER VINTAGE RED PAISLEY    80
           JUMBO BAG PINK POLKADOT             73
           JUMBO BAG VINTAGE LEAF              71
           JUMBO STORAGE BAG SUKI              70
           JUMBO  BAG BAROQUE BLACK WHITE      67
           JUMBO BAG APPLES                    61
           JUMBO BAG ALPHABET                  59
           LUNCH BAG  BLACK SKULL.             56
           JUMBO STORAGE BAG SKULLS            56
dtype: int64

Would you like to enter another Customer ID? (yes/no): yea
Thank you!
```

CONCLUSION:

In conclusion, online recommendation systems have revolutionized the way users interact with online services, providing personalized experiences that drive engagement, conversion, and loyalty. As technology continues to evolve, we can expect to see even more sophisticated and effective recommendation systems that prioritize user satisfaction and business success.