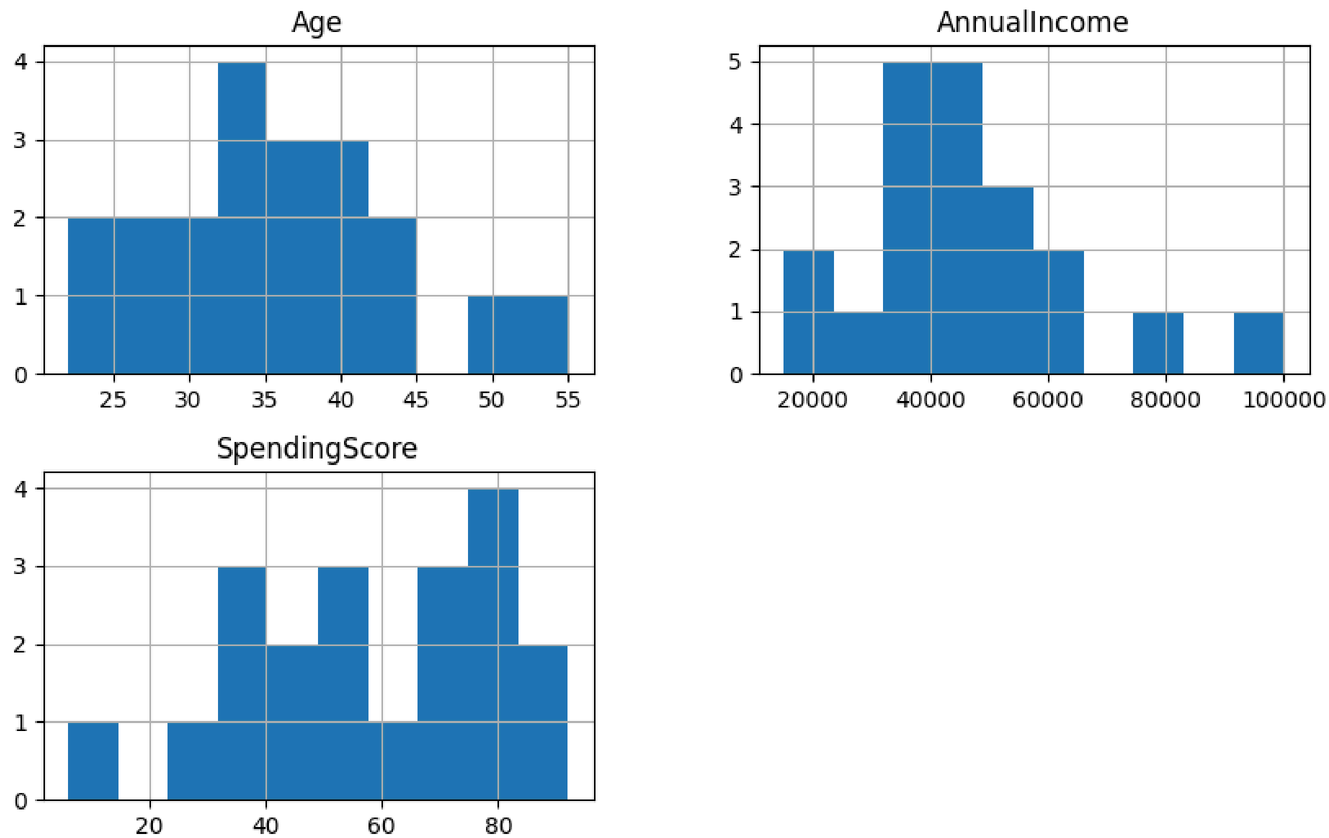
K-means clustering problem using Python

Exercise 1: Data Exploration and Preprocessing

```
# Importing required libraries
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import StandardScaler

# Load the dataset
df = pd.read_csv('customer_segmentation.csv')

# Display first few rows
print(df.head())

# Check for missing values
print(df.isnull().sum())

# Data exploration - Histograms for Age, Annual Income, and Spending Score
df[['Age', 'AnnualIncome', 'SpendingScore']].hist(bins=10, figsize=(10, 6))
plt.show()

# Data Normalization using StandardScaler
scaler = StandardScaler()
scaled_data = scaler.fit_transform(df[['Age', 'AnnualIncome', 'SpendingScore']])

# Convert the scaled data back into a DataFrame
df_scaled = pd.DataFrame(scaled_data, columns=['Age', 'AnnualIncome', 'SpendingScore'])
print(df_scaled.head())
```

```
   CustomerID  Age  AnnualIncome  SpendingScore
0           1   22         15000             39
1           2   35         40000             81
2           3   26         30000             77
3           4   40         50000             40
4           5   55        100000              6
CustomerID       0
Age              0
AnnualIncome     0
SpendingScore    0
dtype: int64
```

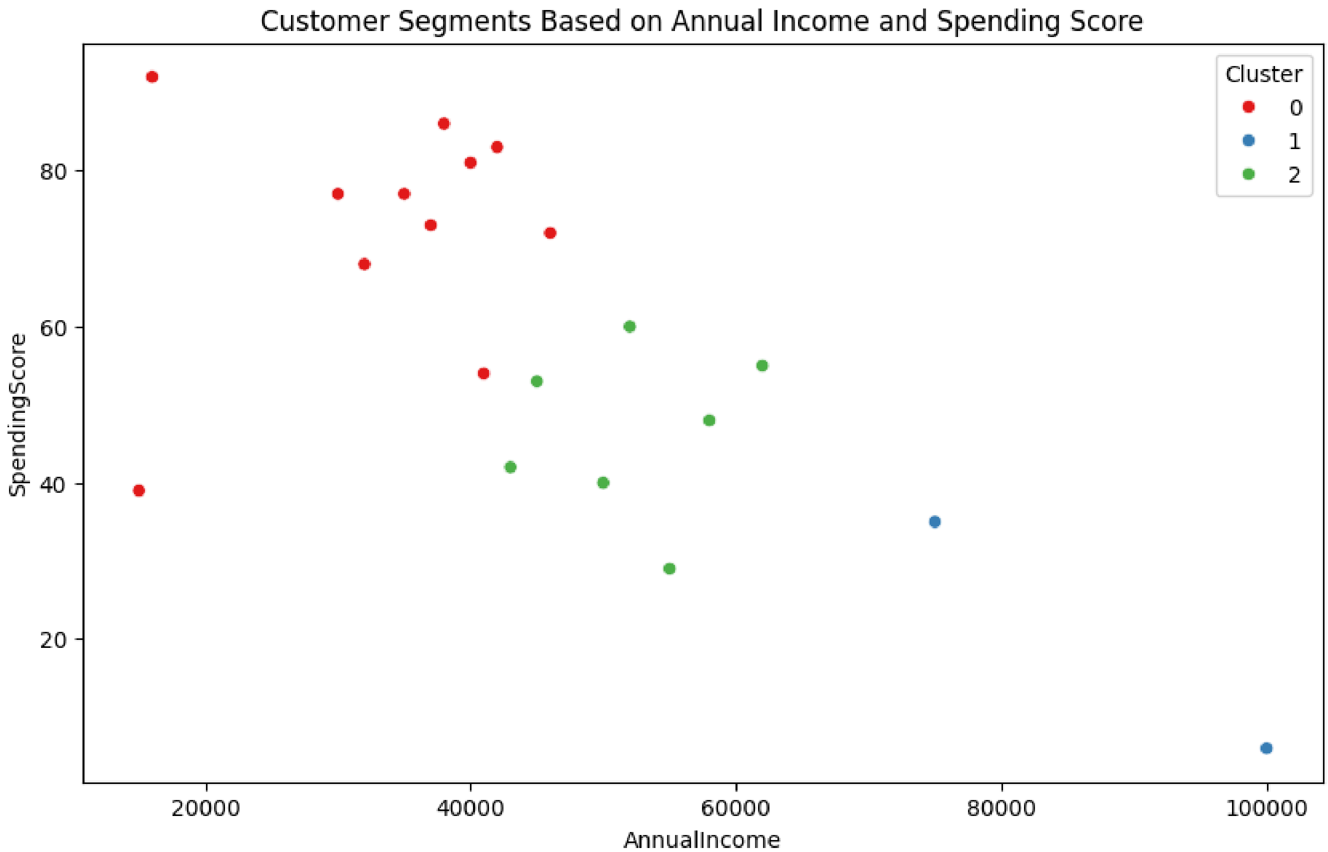



```
        Age  AnnualIncome  SpendingScore
0 -1.658204     -1.641181      -0.894674
1 -0.096128     -0.300347       1.032316
2 -1.177565     -0.836681       0.848794
3  0.504671      0.235987      -0.848794
4  2.307066      2.917656      -2.408738
```

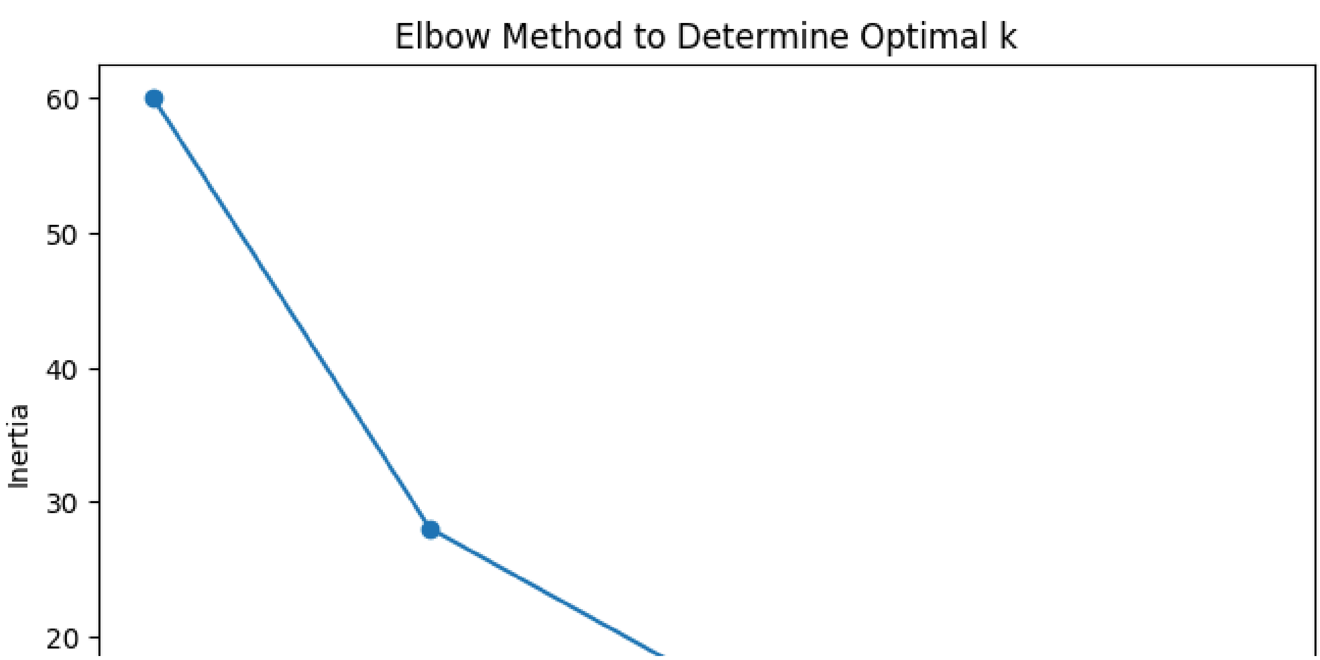
Exercise 2: Implementing K-Means Clustering

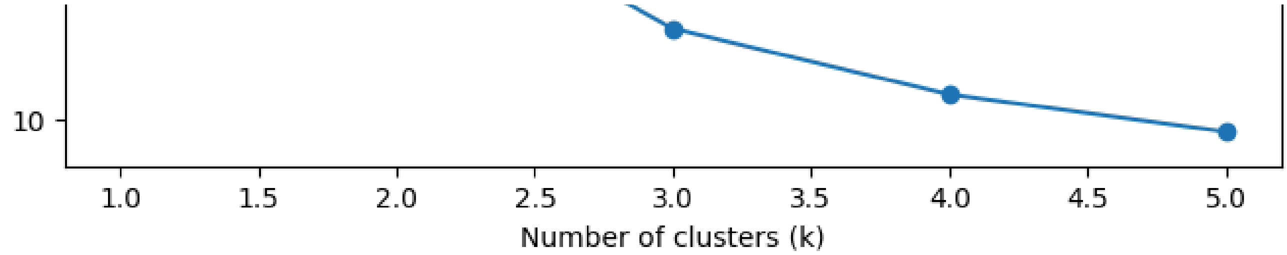
```
from sklearn.cluster import KMeans

# Initial model implementation with k=3
kmeans = KMeans(n_clusters=3, random_state=42)
df['Cluster'] = kmeans.fit_predict(df_scaled)

# Visualizing the clusters
plt.figure(figsize=(10, 6))
sns.scatterplot(x='AnnualIncome', y='SpendingScore', hue='Cluster', data=df, palette='Set1')
plt.title('Customer Segments Based on Annual Income and Spending Score')
plt.show()

# Elbow Method to determine the optimal k
inertia = []
k_values = range(1, 6)
for k in k_values:
    kmeans = KMeans(n_clusters=k, random_state=42)
    kmeans.fit(df_scaled)
    inertia.append(kmeans.inertia_)

# Plotting the Elbow Method
plt.figure(figsize=(8, 5))
plt.plot(k_values, inertia, marker='o')
plt.title('Elbow Method to Determine Optimal k')
plt.xlabel('Number of clusters (k)')
plt.ylabel('Inertia')
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
```




```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
```

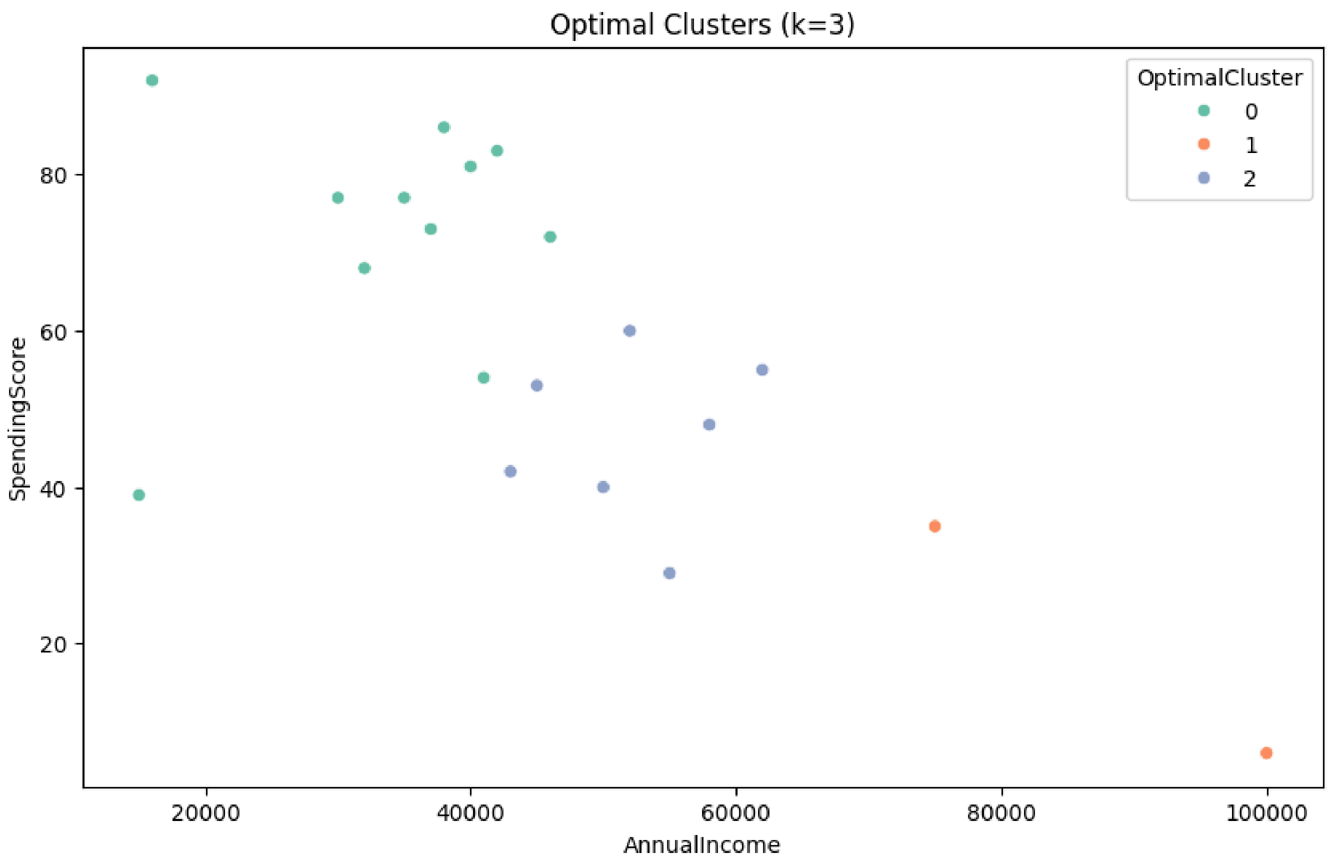




Exercise 3: Model Evaluation

```
from sklearn.metrics import silhouette_score

# Calculate silhouette scores for different values of k
for k in range(2, 6):
    kmeans = KMeans(n_clusters=k, random_state=42)
    clusters = kmeans.fit_predict(df_scaled)
    silhouette_avg = silhouette_score(df_scaled, clusters)
    print(f'For k={k}, the silhouette score is {silhouette_avg:.3f}')

# Based on the silhouette score and elbow method, let's assume k=3 is optimal
optimal_k = 3
kmeans = KMeans(n_clusters=optimal_k, random_state=42)
df['OptimalCluster'] = kmeans.fit_predict(df_scaled)

# Visualizing the optimal clusters
plt.figure(figsize=(10, 6))
sns.scatterplot(x='AnnualIncome', y='SpendingScore', hue='OptimalCluster', data=df, palette=
plt.title(f'Optimal Clusters (k={optimal_k})')
plt.show()

# Cluster analysis by averaging the features for each cluster
cluster_summary = df.groupby('OptimalCluster').mean()
print(cluster_summary)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning:
  super()._check_params_vs_input(X, default_n_init=10)
For k=2, the silhouette score is 0.431
For k=3, the silhouette score is 0.396
For k=4, the silhouette score is 0.402
For k=5, the silhouette score is 0.350
```



	CustomerID	Age	AnnualIncome	SpendingScore	Cluster
OptimalCluster					
0	9.272727	30.090909	33818.181818	72.909091	0.0
1	6.000000	52.500000	87500.000000	20.500000	1.0
2	13.714286	40.000000	52142.857143	46.714286	2.0