Assignment 5

Dataset: https://www.kaggle.com/datasets/vjchoudhary7/customer-segmentation-tutorial-in-python/data (https://www.kaggle.com/datasets/vjchoudhary7/customer-segmentation-tutorial-in-python/data)

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21BCE1440

In [1]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.metrics import silhouette_score
from sklearn import cluster
```

Task 1: Understanding the dataset

In [2]:
```
#read the dataset
df=pd.read_csv('./Mall_Customers.csv')
df.head()
```

Out[2]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

In [3]:
```
df.columns
```

Out[3]:
```
Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)'],
      dtype='object')
```

In [4]:
```
1 df.describe()
```

Out[4]:

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000
mean	100.500000	38.850000	60.560000	50.200000
std	57.879185	13.969007	26.264721	25.823522
min	1.000000	18.000000	15.000000	1.000000
25%	50.750000	28.750000	41.500000	34.750000
50%	100.500000	36.000000	61.500000	50.000000
75%	150.250000	49.000000	78.000000	73.000000
max	200.000000	70.000000	137.000000	99.000000

In [5]:
```
1 df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   CustomerID              200 non-null    int64
 1   Gender                  200 non-null    object
 2   Age                     200 non-null    int64
 3   Annual Income (k$)      200 non-null    int64
 4   Spending Score (1-100)  200 non-null    int64
dtypes: int64(4), object(1)
memory usage: 7.9+ KB
```

In [6]:
```
1 df['Gender'].value_counts()
```

Out[6]:
```
Female    112
Male       88
Name: Gender, dtype: int64
```

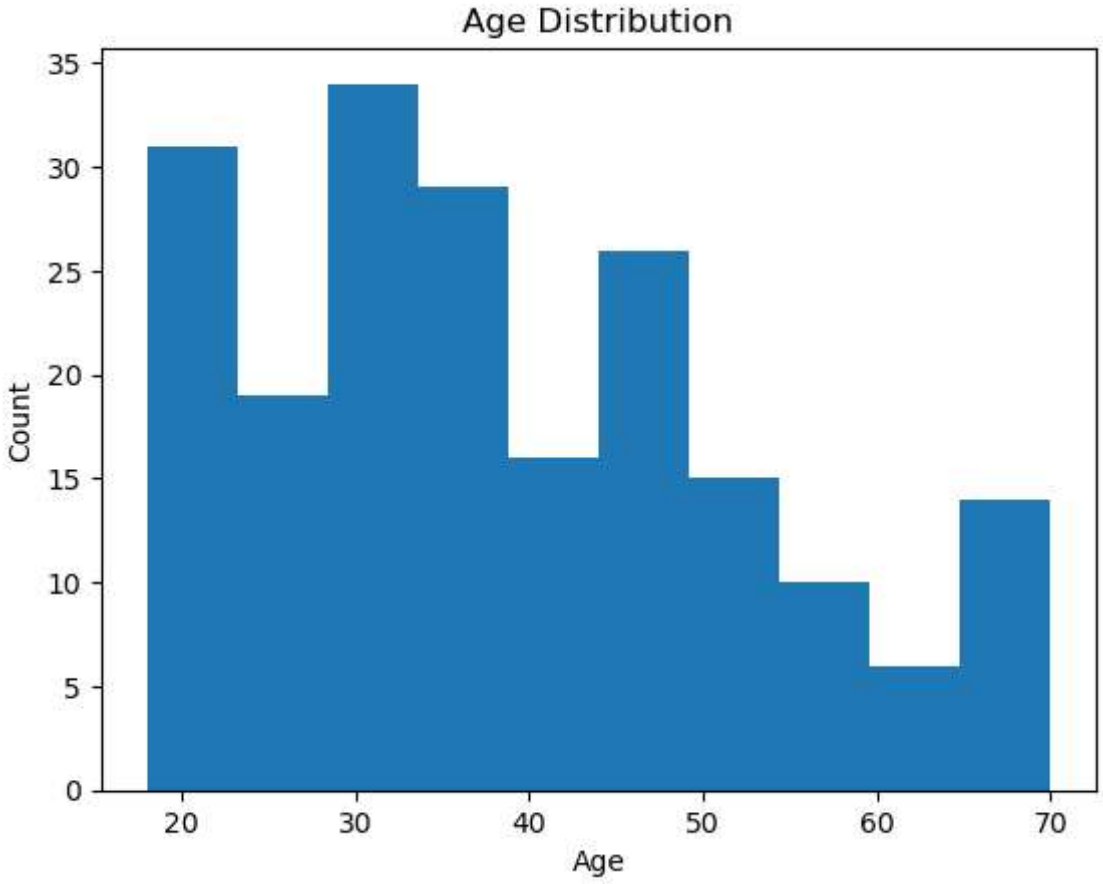
In [7]:
```
1 #Removing unique column
2 df.drop(columns=['CustomerID'],axis=1,inplace=True)
```

Visualizations

Univariate

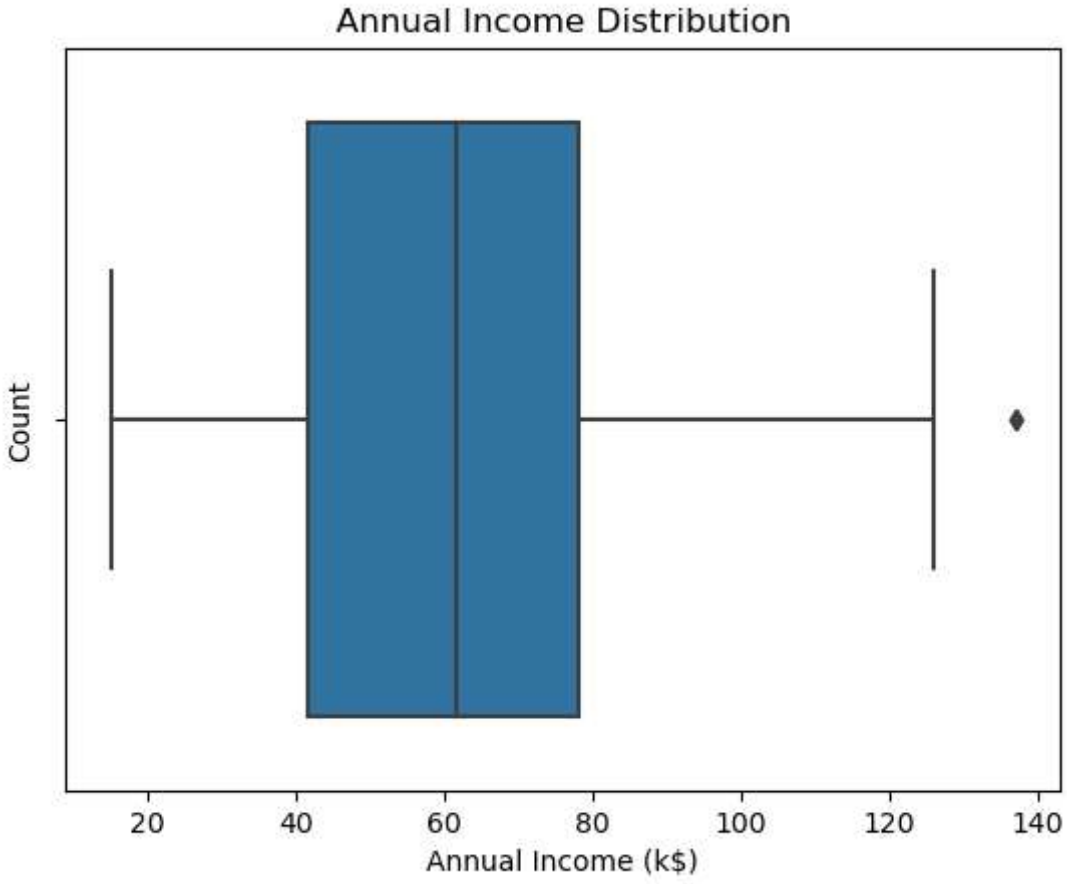
In [8]:

```
plt.hist(df['Age'], bins=10)
plt.title('Age Distribution')
plt.xlabel('Age')
plt.ylabel('Count')
plt.show()
```



In [9]:

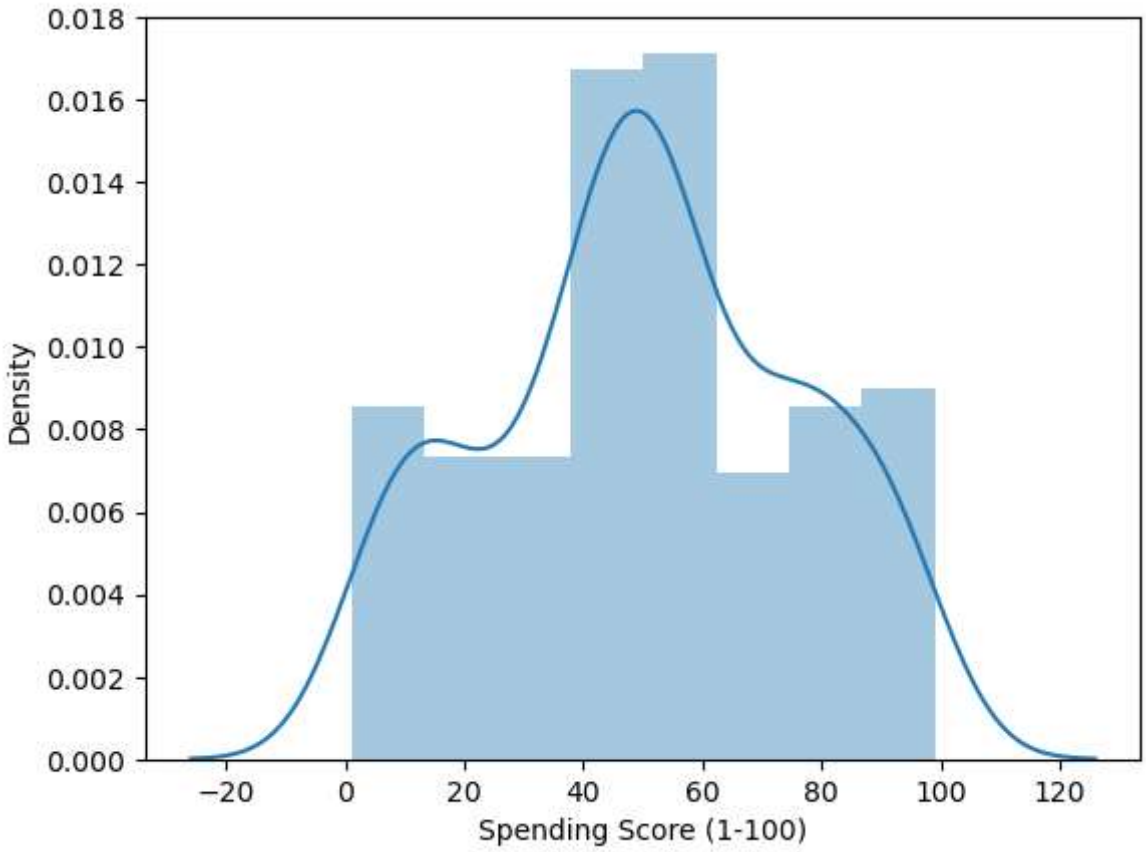
```
sns.boxplot(x=df['Annual Income (k$)'])
plt.title('Annual Income Distribution')
plt.xlabel('Annual Income (k$)')
plt.ylabel('Count')
plt.show()
```



In [10]:
```
1 sns.distplot(df['Spending Score (1-100)'])
```

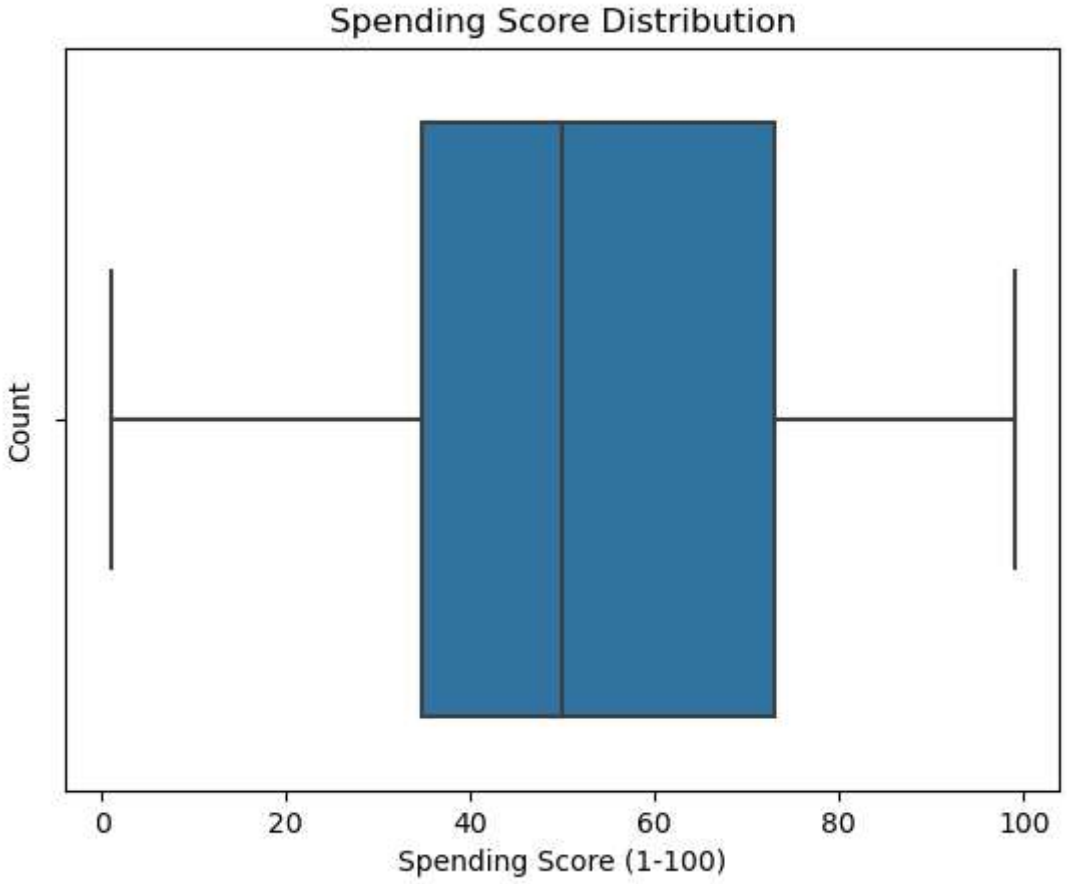
```
C:\Users\Charvi Upreti\AppData\Local\Temp\ipykernel_9708\3737231236.py:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751 (https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751)

  sns.distplot(df['Spending Score (1-100)'])
```

Out[10]: <Axes: xlabel='Spending Score (1-100)', ylabel='Density'>



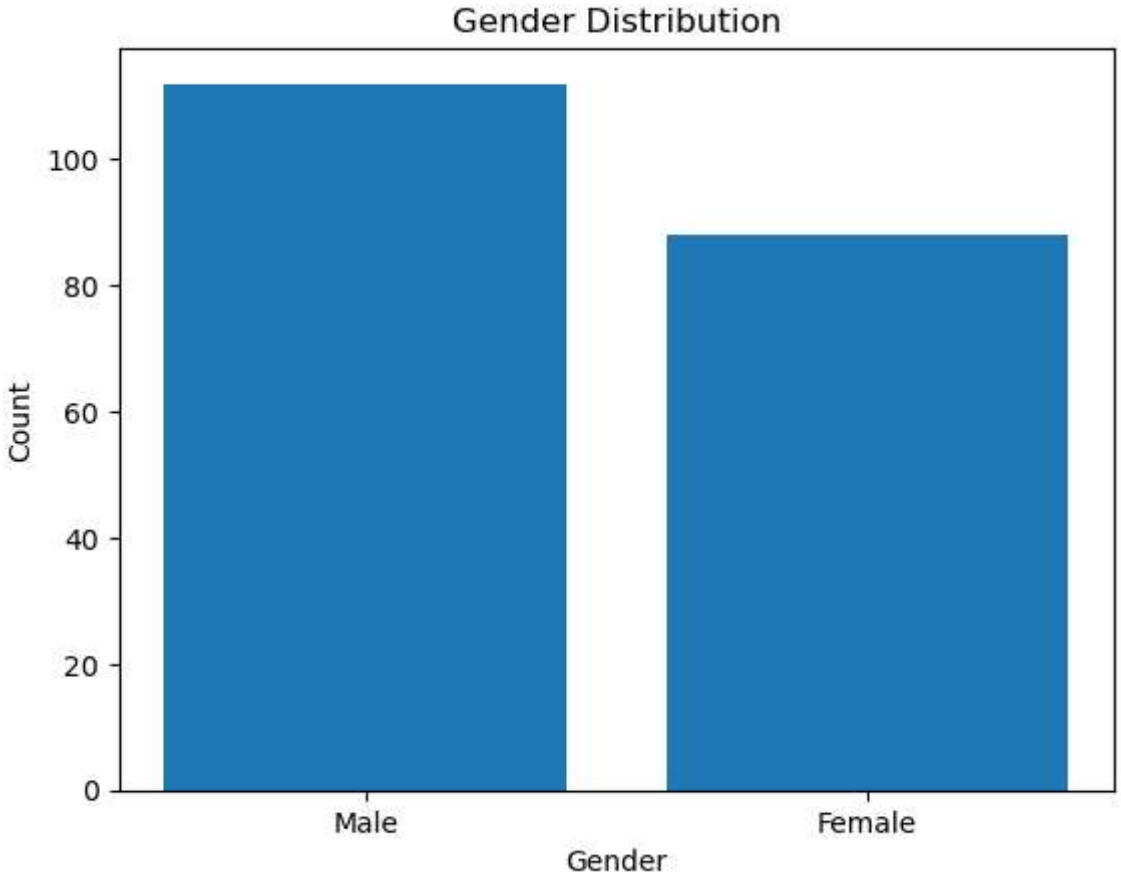
In [11]:

```
sns.boxplot(x=df['Spending Score (1-100)'])
plt.title('Spending Score Distribution')
plt.xlabel('Spending Score (1-100)')
plt.ylabel('Count')
plt.show()
```



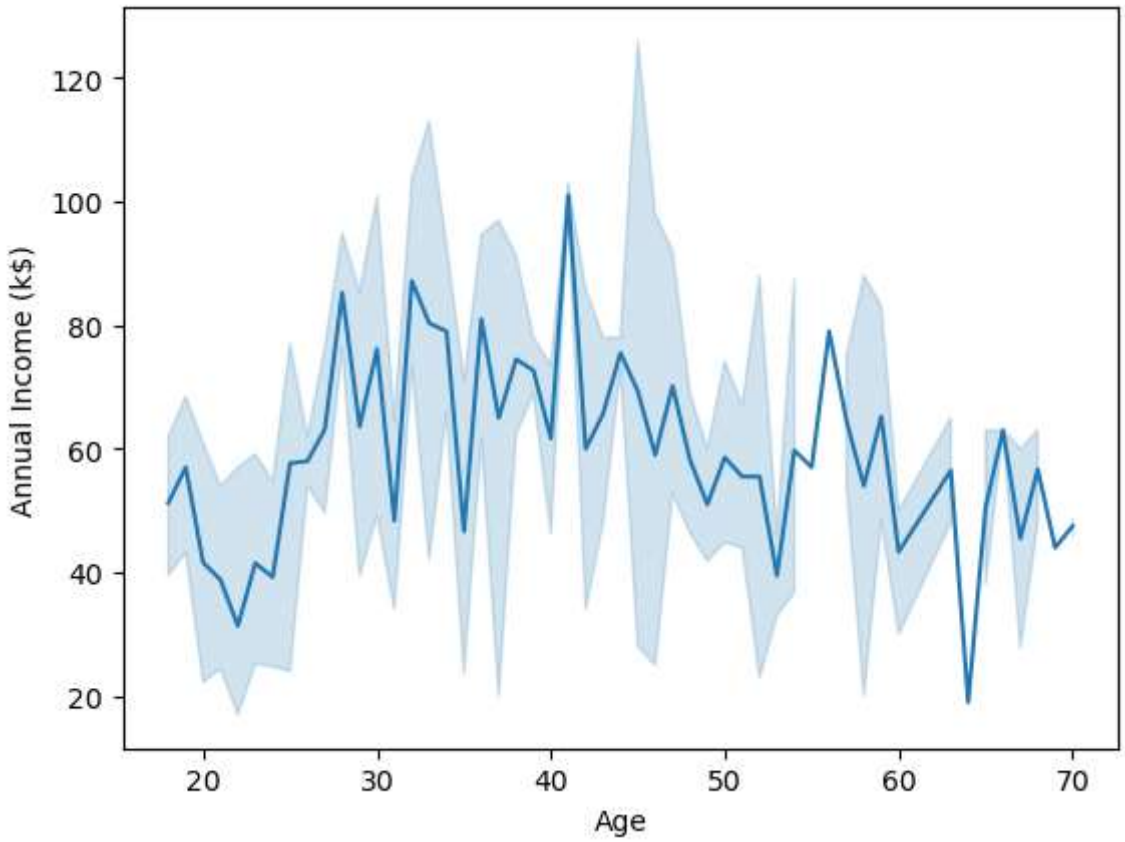
In [12]:

```
plt.bar(df['Gender'].unique(), df['Gender'].value_counts())
plt.title('Gender Distribution')
plt.xlabel('Gender')
plt.ylabel('Count')
plt.show()
```

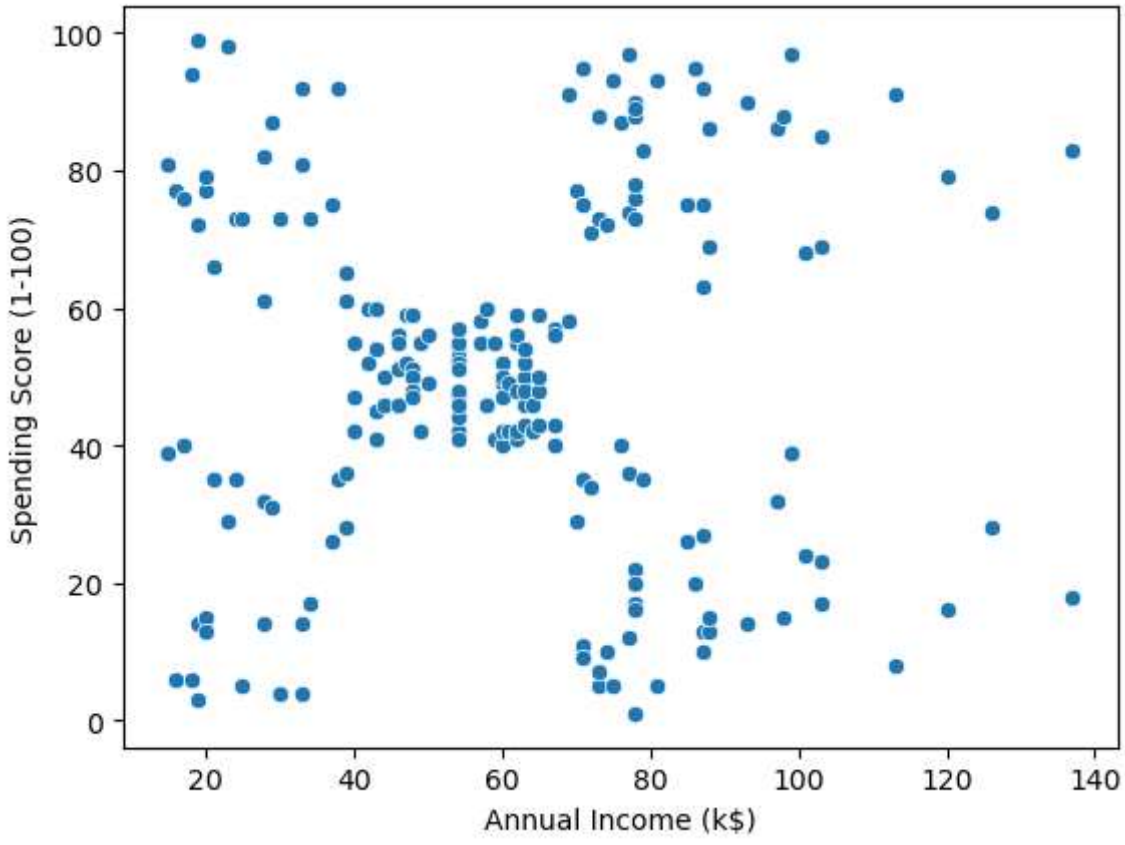


Bivariate

In [13]:
```
1 sns.lineplot(x='Age', y='Annual Income (k$)', data=df)
2 plt.show()
```



In [14]:
```
1 sns.scatterplot(x='Annual Income (k$)', y='Spending Score (1-100)', data=df)
2 plt.show()
```

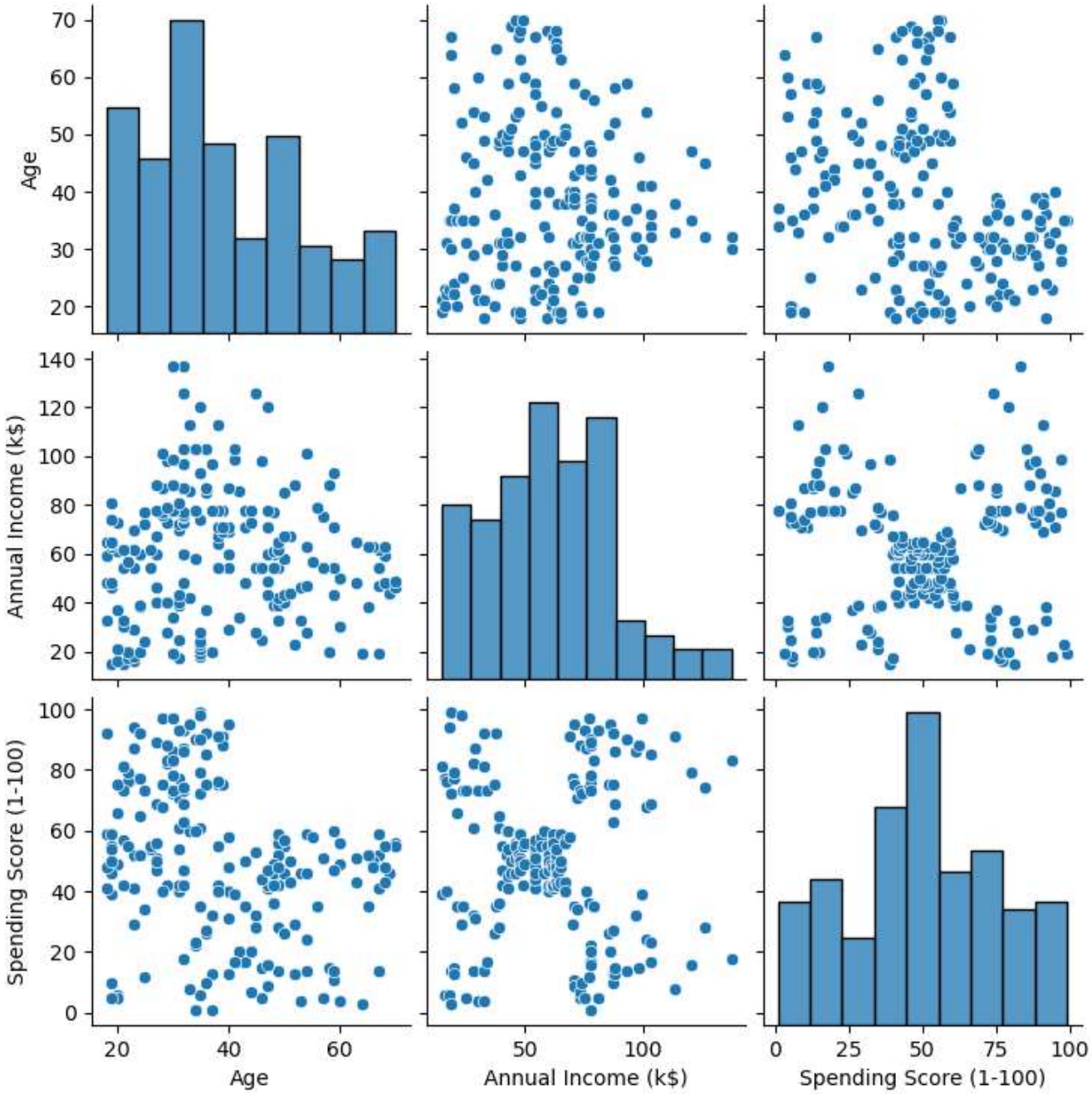


Multivariate

In [15]:
```
1 sns.pairplot(df)
```

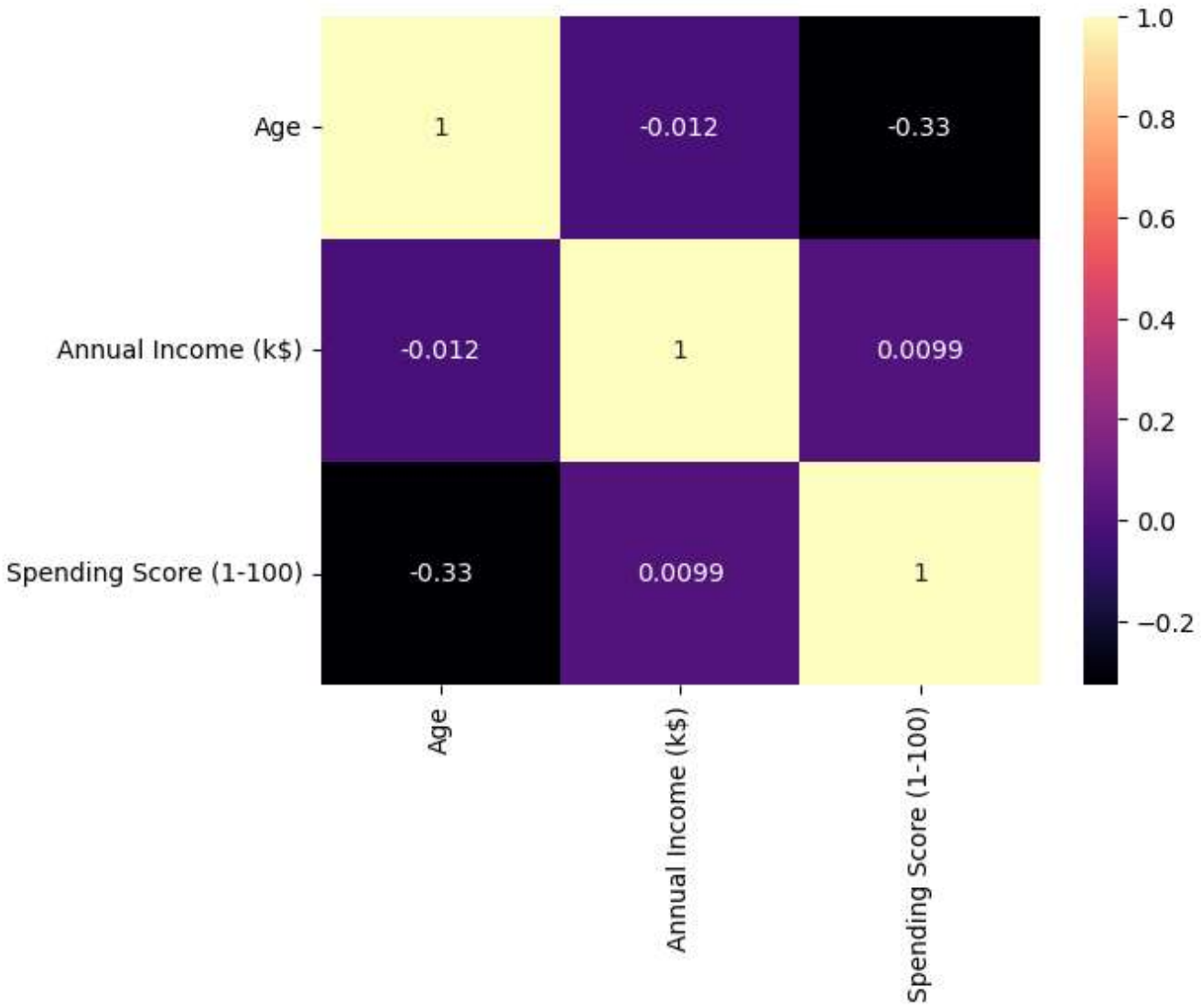
```
C:\Users\Charvi Upreti\anaconda3\lib\site-packages\seaborn\axisgrid.py:118: UserWarnin
g: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```

Out[15]: <seaborn.axisgrid.PairGrid at 0x21ffd02da60>



In [16]:
```
1 sns.heatmap(df.corr(), annot=True, cmap='magma')
```

Out[16]: <Axes: >



Task 2: Data Preprocessing

In [17]:
```
1 df.isnull().sum()
```

Out[17]:
```
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

In [18]:
```
1 df.shape
```

Out[18]: (200, 4)

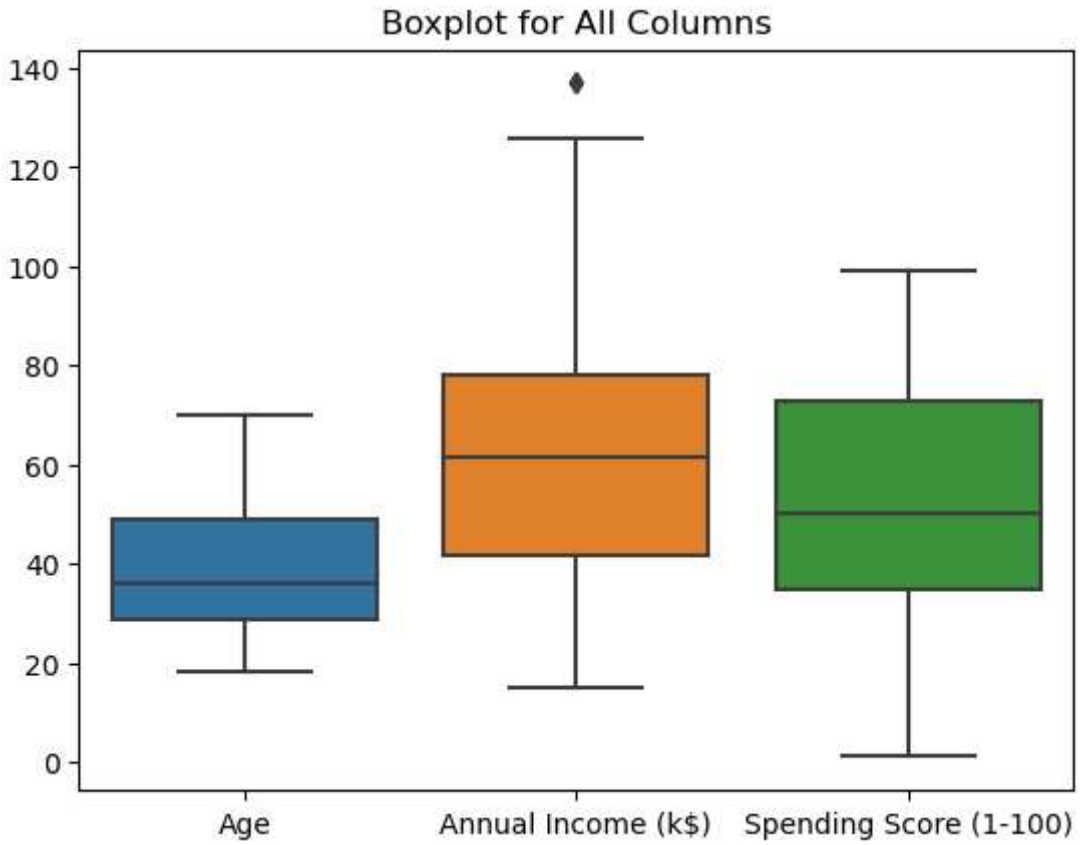
In [19]:
```
1 df
```

Out[19]:

	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	Male	19	15	39
1	Male	21	15	81
2	Female	20	16	6
3	Female	23	16	77
4	Female	31	17	40
...	...	...	...	...
195	Female	35	120	79
196	Female	45	126	28
197	Male	32	126	74
198	Male	32	137	18
199	Male	30	137	83

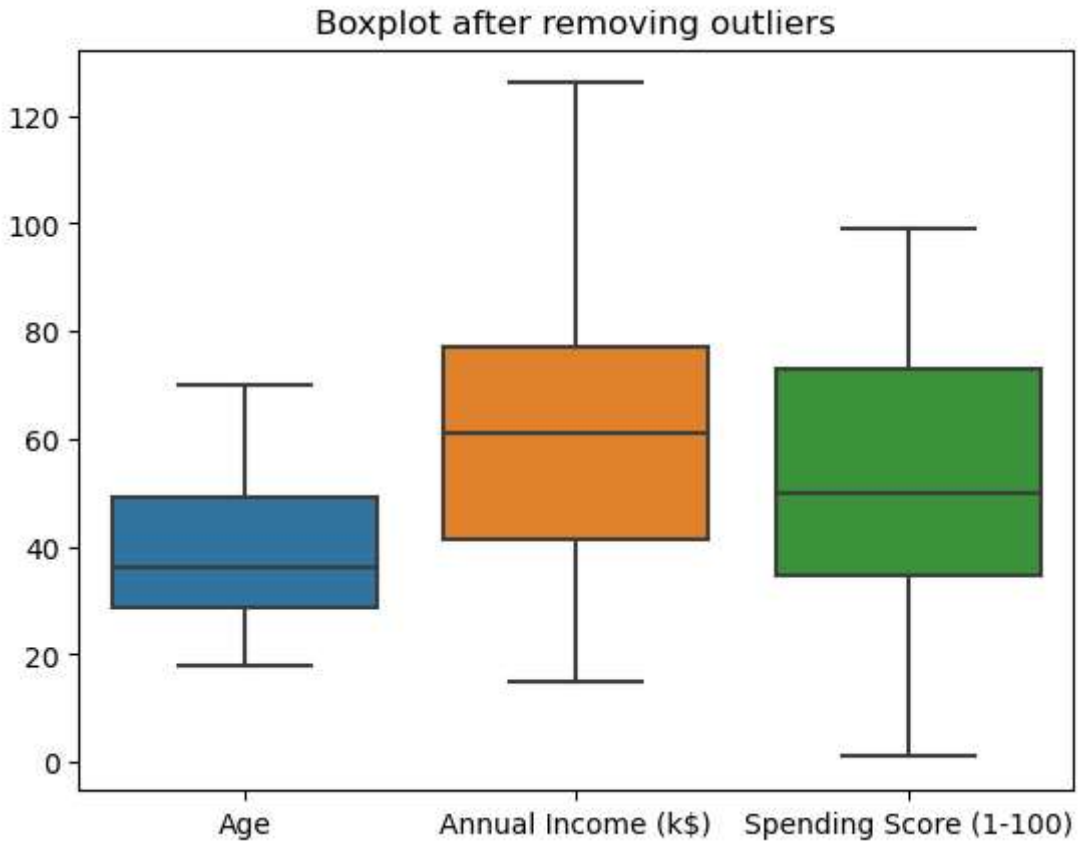
200 rows × 4 columns

In [20]:
```
1 sns.boxplot(data=df)
2 plt.title('Boxplot for All Columns')
3 plt.show()
```



In [21]:
```
col='Annual Income (k$)'
q1 = df[col].quantile(0.25)
q3 = df[col].quantile(0.75)
IQR = q3 - q1
upper_limit = q3 + 1.5 * IQR
lower_limit = q1 - 1.5 * IQR
median=df[col].median()
df[col] = np.where(df[col] > upper_limit,median , df[col])
df[col] = np.where(df[col] < lower_limit, median, df[col])
```

In [22]:
```
sns.boxplot(data=df)
plt.title('Boxplot after removing outliers')
plt.show()
```



In [23]:
```
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()
```

In [24]:
```
df['Gender']=le.fit_transform(df['Gender'])
```

In [25]:
```
1 df
```

Out[25]:

	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	19	15.0	39
1	1	21	15.0	81
2	0	20	16.0	6
3	0	23	16.0	77
4	0	31	17.0	40
...	...	...	...	...
195	0	35	120.0	79
196	0	45	126.0	28
197	1	32	126.0	74
198	1	32	61.5	18
199	1	30	61.5	83

200 rows × 4 columns

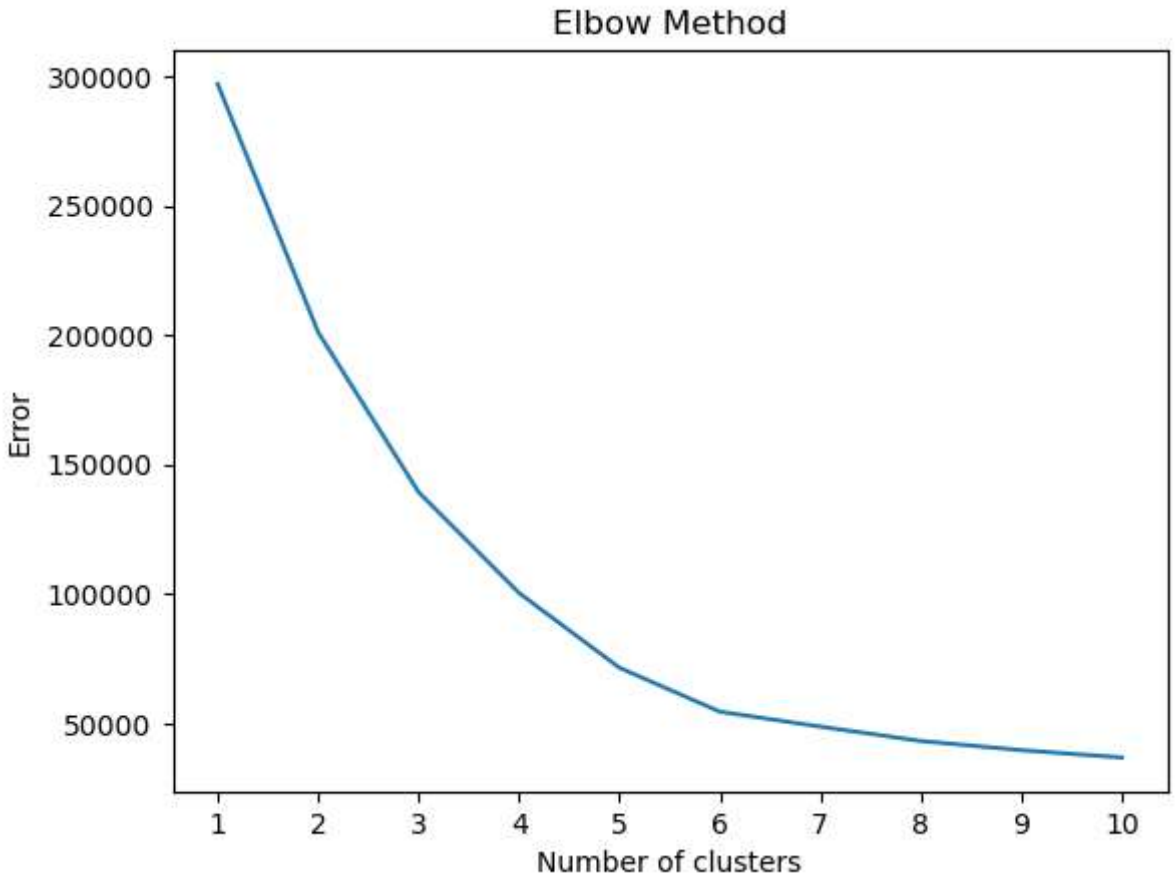
Task 3: Machine Learning approach with clustering algorithm

In [26]:
```
1 error=[]
2 for i in range(1,11):
3     kmeans=cluster.KMeans(n_clusters=i,init='k-means++',random_state=0,n_init=10)
4     kmeans.fit(df)
5     error.append(kmeans.inertia_)
```

In [27]:
```
1 error
```

Out[27]:
```
[297063.675,
 201152.1081841432,
 139326.23321730687,
 100349.31619915174,
 71419.31019600156,
 54455.93879921248,
 48690.465943332725,
 43131.173664941765,
 39592.88814870235,
 36749.14386219665]
```

In [28]:
```
plt.plot(range(1,11),error)
plt.title('Elbow Method')
plt.xlabel('Number of clusters')
plt.ylabel('Error')
plt.xticks(range(1, 11))
plt.show()
```



Taking n_clusters = 5

In [29]:
```
kmeans = cluster.KMeans(n_clusters=5, init='k-means++', random_state=0, n_init=10)
kmeans.fit(df)
cluster_labels = kmeans.predict(df)
silhouette_avg = silhouette_score(df, cluster_labels)
print(f"Silhouette Score: {silhouette_avg}")
```

```
Silhouette Score: 0.4453872753985074
```

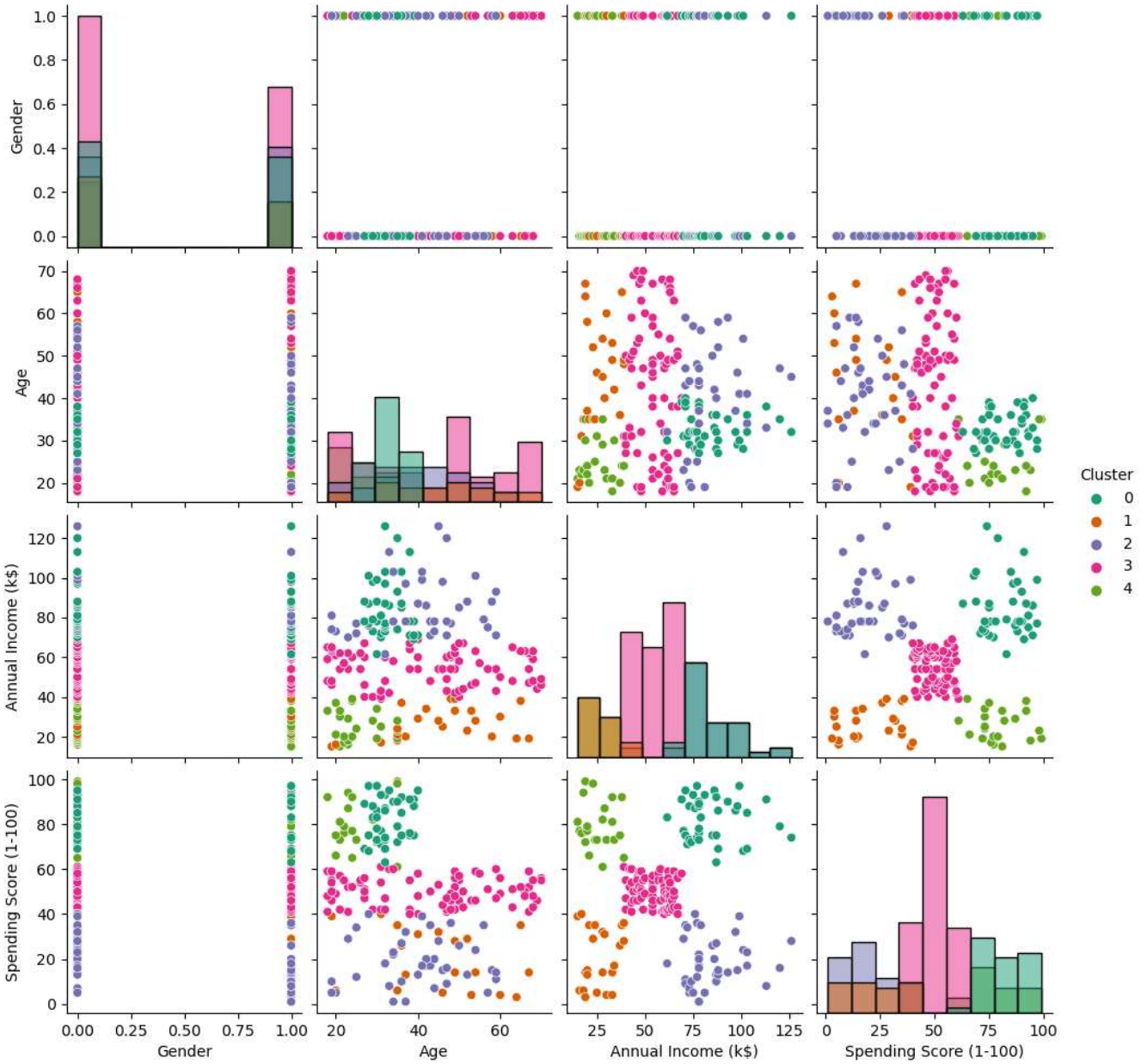
In [30]:
```
cluster_labels
```

Out[30]:
```
array([1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4,
       1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 4, 1, 3,
       1, 4, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 0, 2, 0, 2, 0, 2, 0, 2, 0,
       2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0,
       2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0,
       2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 0,
       2, 0])
```

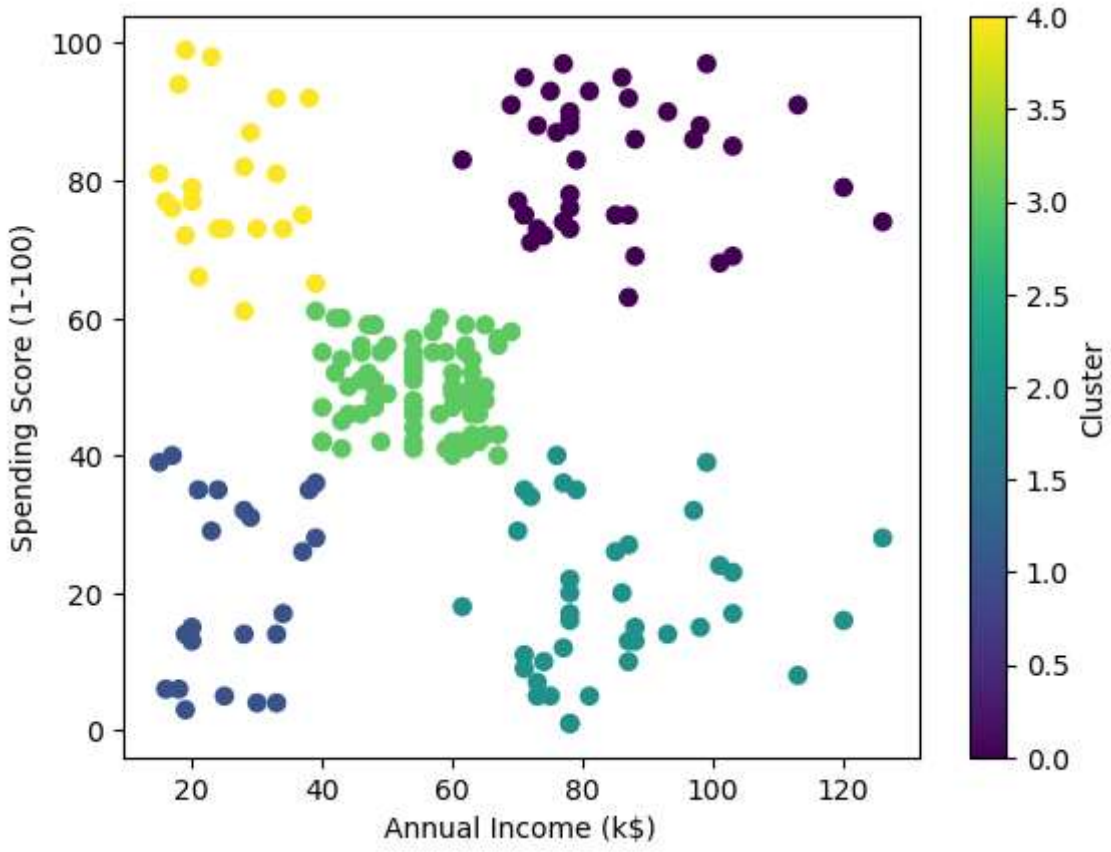
In [31]:

```
df_visualization = df.copy()
df_visualization['Cluster'] = cluster_labels
columns_to_plot = ['Gender', 'Age', 'Annual Income (k$)', 'Spending Score (1-100)',
sns.pairplot(df_visualization[columns_to_plot], hue='Cluster', palette='Dark2', dia
plt.show()

```

```
C:\Users\Charvi Upreti\anaconda3\lib\site-packages\seaborn\axisgrid.py:118: UserWarnin
g: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```



In [32]:
```
plt.scatter(df_visualization['Annual Income (k$)'], df_visualization['Spending Scor
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.colorbar(label='Cluster')
plt.show()
```



Test with random obervation

In [33]:
```
kmeans.predict([[1,19,15,40]])
```

```
C:\Users\Charvi Upreti\AppData\Roaming\Python\Python39\site-packages\sklearn\base.py:4
64: UserWarning: X does not have valid feature names, but KMeans was fitted with featu
re names
  warnings.warn(
```

Out[33]:
```
array([1])
```

In [34]:
```
kmeans.predict([[0,20,16,81]])
```

```
C:\Users\Charvi Upreti\AppData\Roaming\Python\Python39\site-packages\sklearn\base.py:4
64: UserWarning: X does not have valid feature names, but KMeans was fitted with featu
re names
  warnings.warn(
```

Out[34]:
```
array([4])
```

Trying scaling

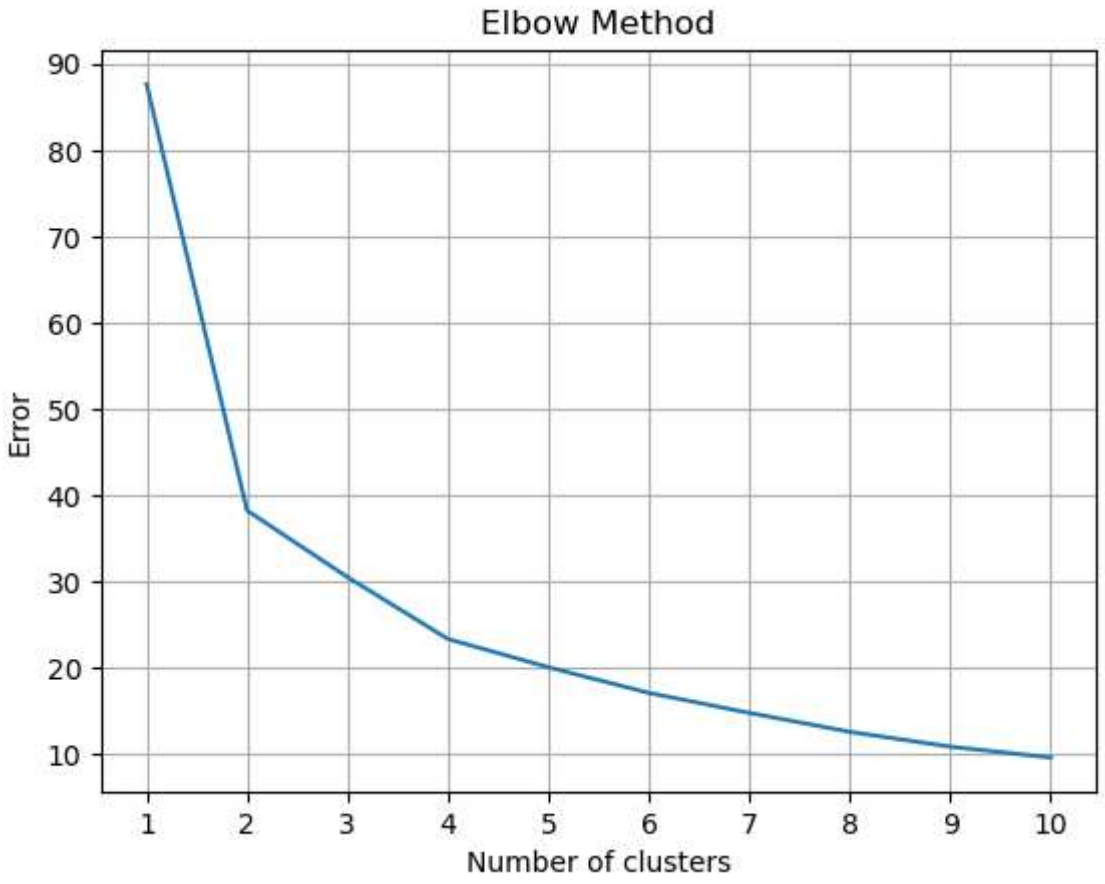
In [35]:
```
from sklearn.preprocessing import MinMaxScaler
scale = MinMaxScaler()
df= pd.DataFrame(scale.fit_transform(df),columns=df.columns)
df.head()
```

Out[35]:

	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1.0	0.019231	0.000000	0.387755
1	1.0	0.057692	0.000000	0.816327
2	0.0	0.038462	0.009009	0.051020
3	0.0	0.096154	0.009009	0.775510
4	0.0	0.250000	0.018018	0.397959

In [36]:
```
error1=[]
for i in range(1,11):
    kmeans1=cluster.KMeans(n_clusters=i,init='k-means++',random_state=10,n_init=10)
    kmeans1.fit(df)
    error1.append(kmeans1.inertia_)
```

In [37]:
```
plt.plot(range(1,11),error1)
plt.title('Elbow Method')
plt.xlabel('Number of clusters')
plt.ylabel('Error')
plt.xticks(range(1, 11))
plt.grid(True)
plt.show()
```

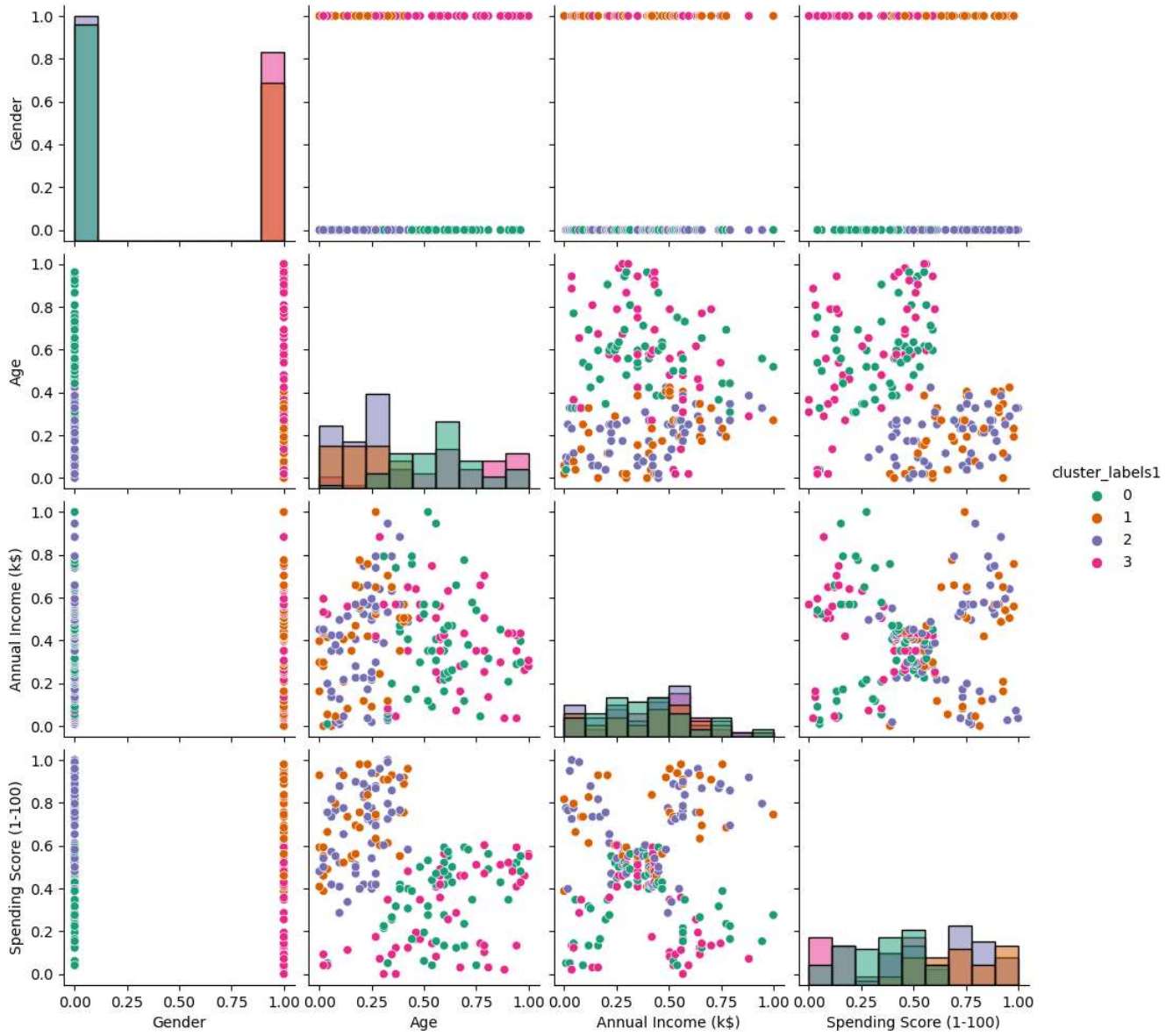


In [38]:
```
kmeans2 = cluster.KMeans(n_clusters=4, init='k-means++', random_state=10, n_init=10
kmeans2.fit(df)
cluster_labels1 = kmeans2.predict(df)
silhouette_avg = silhouette_score(df, cluster_labels1)
print(f"Silhouette Score: {silhouette_avg}")
```

```
Silhouette Score: 0.35593685367887445
```

In [39]:
```
import matplotlib.pyplot as plt
df_visualization = df.copy()
df_visualization['cluster_labels1'] = cluster_labels1
columns_to_plot = ['Gender', 'Age', 'Annual Income (k$)', 'Spending Score (1-100)',
sns.pairplot(df_visualization[columns_to_plot], hue='cluster_labels1', palette='Dar
plt.show()

```

```
C:\Users\Charvi Upreti\anaconda3\lib\site-packages\seaborn\axisgrid.py:118: UserWarnin
g: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```



Silhouette Score is more at n_clusters=5 without scaling.