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

In [2]:
```python
df = pd.read_csv('Mall_Customers.csv')
```

In [3]:
```python
df.head()
```

Out[3]:

	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 [5]:
```python
df.shape
```

Out[5]:
```
(200, 5)
```

In [6]:
```python
df.describe()
```

Out[6]:

	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 [7]:
```python
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 [8]:
```python
#Checking for null values
df.isnull().sum()
```

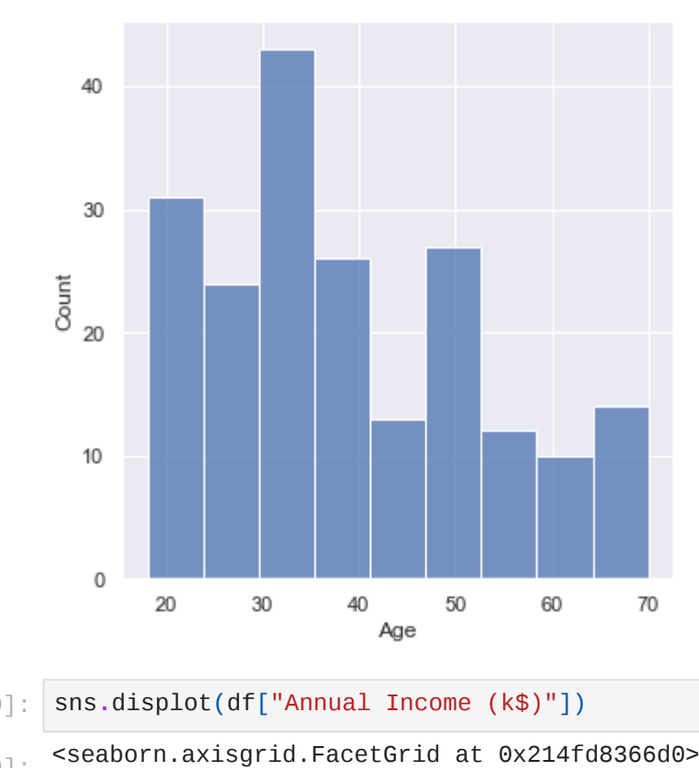
Out[8]:
```
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

In [18]:
```python
# Perform EDA on the data
print(df.describe())
df.hist(bins=50, figsize=(20,15))
plt.show()
```

```
       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
```

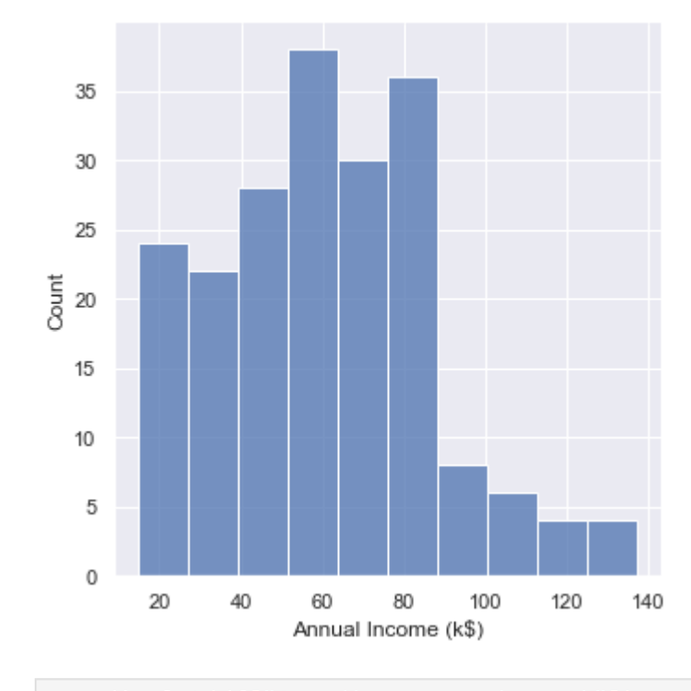
In [19]:
```python
sns.displot(df["Age"])
```

Out[19]: `<seaborn.axisgrid.FacetGrid at 0x214fdf5d0a0>`



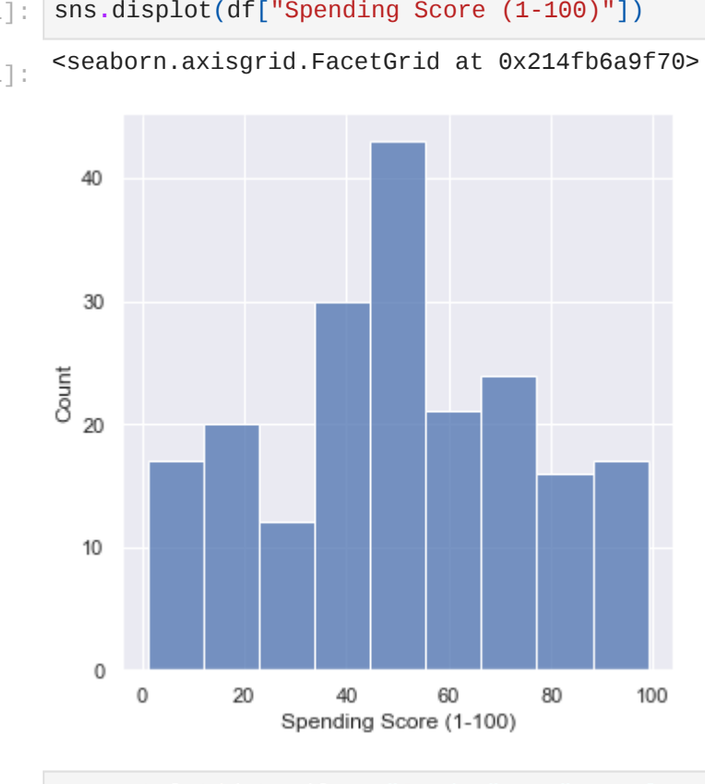
In [20]:
```python
sns.displot(df["Annual Income (k$)"])
```

Out[20]: `<seaborn.axisgrid.FacetGrid at 0x214fd8366d0>`



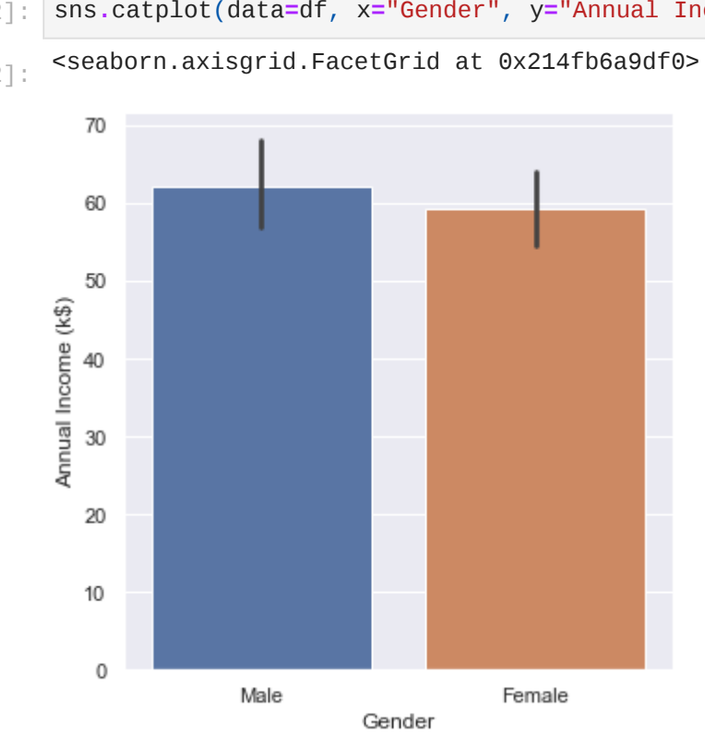
In [21]:
```python
sns.displot(df["Spending Score (1-100)"])
```

Out[21]: `<seaborn.axisgrid.FacetGrid at 0x214fb6a9f70>`



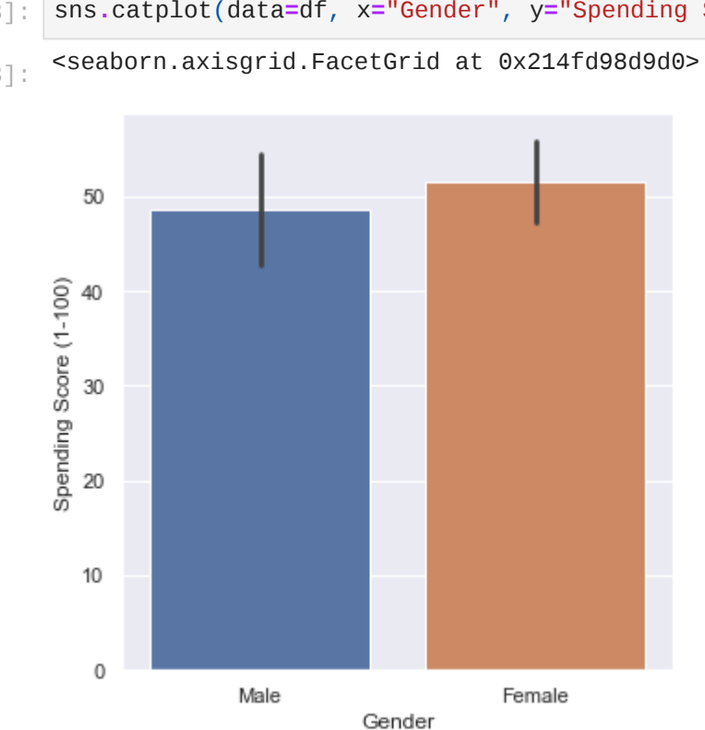
In [22]:
```python
sns.catplot(data=df, x="Gender", y="Annual Income (k$)", kind="bar")
```

Out[22]: `<seaborn.axisgrid.FacetGrid at 0x214fb6a9df0>`



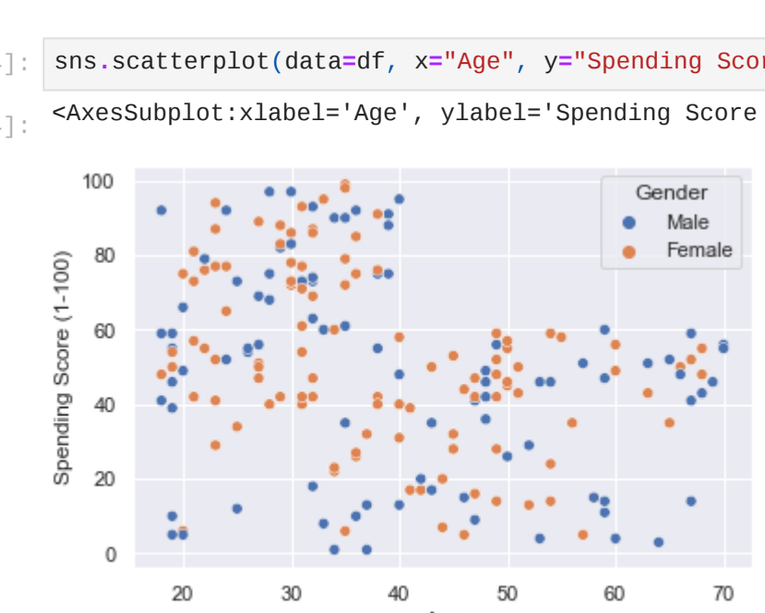
In [23]:
```python
sns.catplot(data=df, x="Gender", y="Spending Score (1-100)", kind="bar")
```

Out[23]: `<seaborn.axisgrid.FacetGrid at 0x214fd98d9d0>`



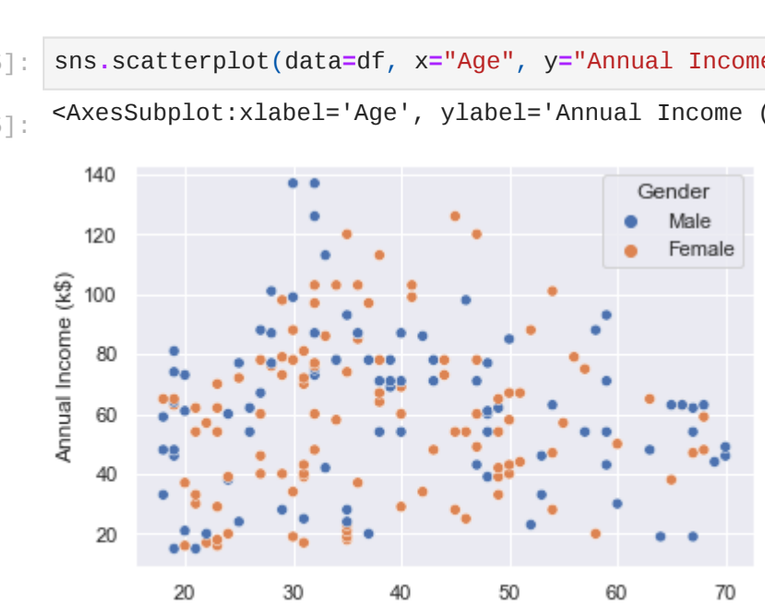
In [24]:
```python
sns.scatterplot(data=df, x="Age", y="Spending Score (1-100)", hue="Gender")
```

Out[24]: `<AxesSubplot:xlabel='Age', ylabel='Spending Score (1-100)'>`



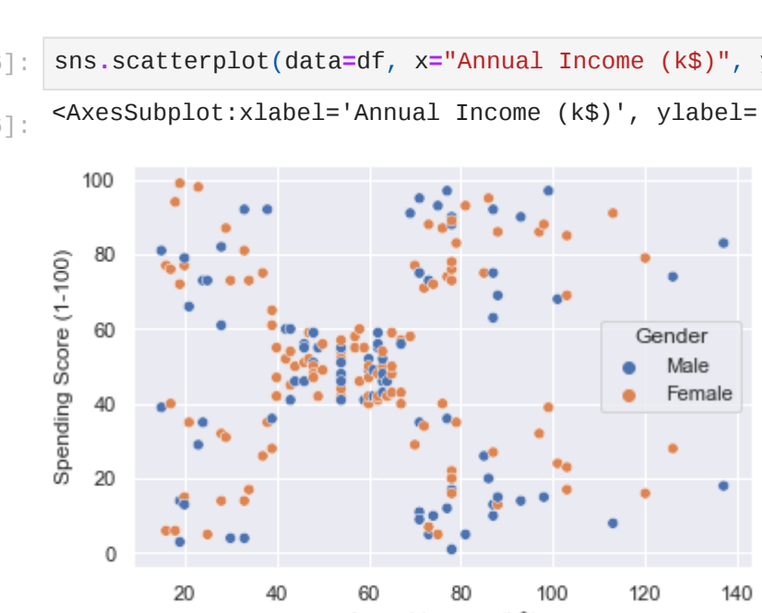
In [25]:
```python
sns.scatterplot(data=df, x="Age", y="Annual Income (k$)", hue="Gender")
```

Out[25]: `<AxesSubplot:xlabel='Age', ylabel='Annual Income (k$)'>`



In [26]:
```python
sns.scatterplot(data=df, x="Annual Income (k$)", y="Spending Score (1-100)", hue="Gender")
```

Out[26]: `<AxesSubplot:xlabel='Annual Income (k$)', ylabel='Spending Score (1-100)'>`



In [10]:
```python
#Now through dataset as we can see that customer's  Annual income and spending score decides if they
X = df.iloc[:,[3,4]].values
print(X)
```

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[[ 15  39]
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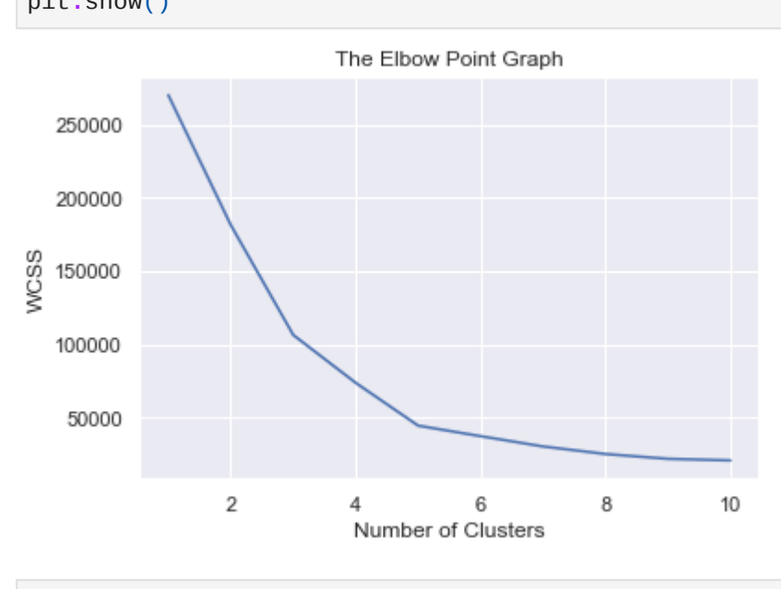
 [103  23]
 [103  69]
 [113   8]
 [113  91]
 [120  16]
 [120  79]
 [126  28]
 [126  74]
 [137  18]
 [137  83]]
```

In [11]:
```python
#Choosing the number of Clusters
#Clustering with respect to Spending score and annual income
wcss = []
##wcsss = Within Clusters Sum of Squares
for i in range(1,11):
    kmeans = KMeans(n_clusters= i , init = 'k-means++' , random_state=0)
    kmeans.fit(X)
    wcss.append(kmeans.inertia_)
```

```
C:\Users\Atharva Yadav\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036: UserWarning: KMeans is known to have a memory leak on Windows with MKL, when there are less chunks than available thre
ads. You can avoid it by setting the environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```

In [12]:
```python
#plot an elbow graph

sns.set()
plt.plot(range(1,11) , wcss)
plt.title('The Elbow Point Graph')
plt.xlabel('Number of Clusters')
plt.ylabel('WCSS')
plt.show()
```



In [15]:
```python
#Training the Kmeans Clustering Model
kmeans = KMeans(n_clusters = 5 , init = 'k-means++' , random_state=0)
Y = kmeans.fit_predict(X)
print(Y)
```

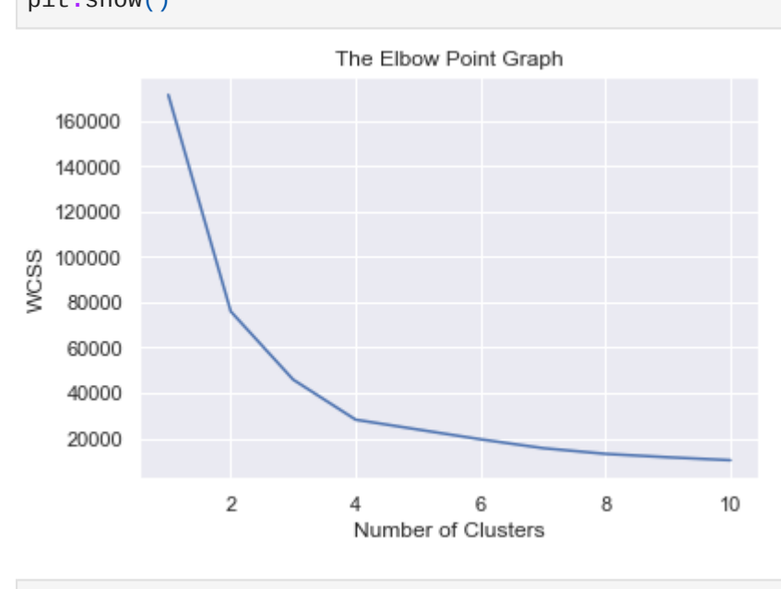
```
[4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4
 3 4 3 4 3 4 1 4 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 2 0 2 1 2 0 2 0 2 1 2 0 2 0 2 0 2 0 2 1 2 0 2 0 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]
```

In [16]:
```python
#Visualizing the Clusters

plt.figure(figsize=(8,8))
plt.scatter(X[Y==0,0], X[Y==0,1], s=50, c='green', label='Cluster 1')
plt.scatter(X[Y==1,0], X[Y==1,1], s=50, c='red', label='Cluster 2')
plt.scatter(X[Y==2,0], X[Y==2,1], s=50, c='yellow', label='Cluster 3')
plt.scatter(X[Y==3,0], X[Y==3,1], s=50, c='violet', label='Cluster 4')
plt.scatter(X[Y==4,0], X[Y==4,1], s=50, c='blue', label='Cluster 5')

# plot the centroids
plt.scatter(kmeans.cluster_centers_[:,0], kmeans.cluster_centers_[:,1], s=100, c='cyan', label='Centroids')

plt.title('Customer type groups')
plt.xlabel('Annual Income')
plt.ylabel('Spending Score')
plt.show()
```

In [27]:
```python
#clustering using age and spending score
X1 = df.iloc[:,[2,4]].values
wcss1 = []
for i in range(1,11):
    kmeans = KMeans(n_clusters= i , init = 'k-means++' , random_state=0)
    kmeans.fit(X1)
    wcss1.append(kmeans.inertia_)
```

```
C:\Users\Atharva Yadav\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036: UserWarning: KMeans is known to have a memory leak on Windows with MKL, when there are less chunks than available thre
ads. You can avoid it by setting the environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```

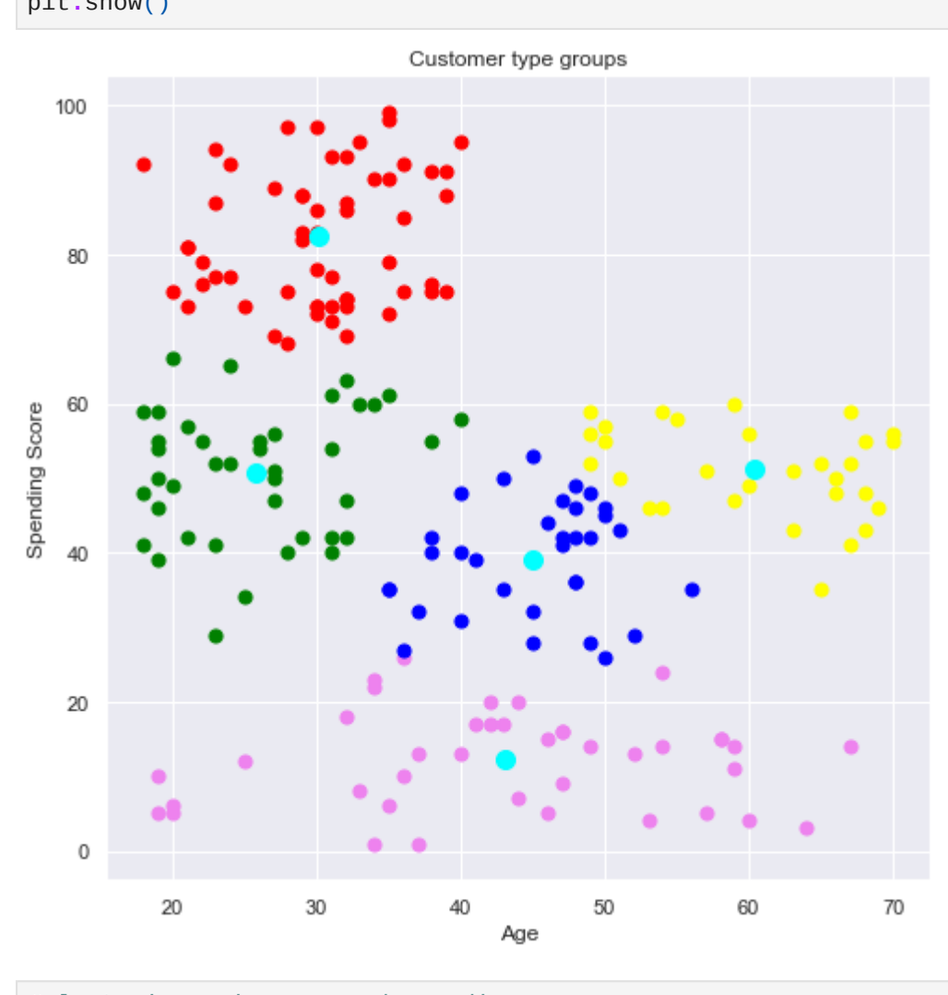
In [29]:
```python
#plotting an elbow graph

sns.set()
plt.plot(range(1,11) , wcss1)
plt.title('The Elbow Point Graph')
plt.xlabel('Number of Clusters')
plt.ylabel('WCSS')
plt.show()
```



In [31]:
```python
#Training the Kmeans Clustering Model
kmeans = KMeans(n_clusters = 5 , init = 'k-means++' , random_state=0)
Y1 = kmeans.fit_predict(X1)
print(Y1)
```

```
[0 1 3 1 0 1 3 1 3 1 3 1 3 1 3 1 4 0 4 1 4 1 3 1 3 1 4 0 4 1 3 1 3 1 3 1 3
 1 3 1 2 1 4 0 4 0 2 0 0 0 2 0 0 2 4 4 2 2 0 2 2 0 2 2 2 0 4 2 0 0 2 4 2 2
 2 0 4 4 0 4 2 0 2 4 0 4 2 0 0 4 2 0 4 4 0 0 4 0 4 0 0 4 2 0 2 0 2 2 2 2 2
 0 4 0 0 0 2 2 4 2 0 4 0 1 0 1 4 1 3 1 3 1 0 1 3 1 3 1 3 1 3 1 0 1 3 1 4 1
 3 1 3 1 3 1 3 1 3 1 4 1 3 1 4 1 3 1 4 0 3 1 3 1 3 1 3 1 3 1 4 1 3 1 4
 1 3 1 3 1 3 1 3 1 3 1 4 1 3 1]
```

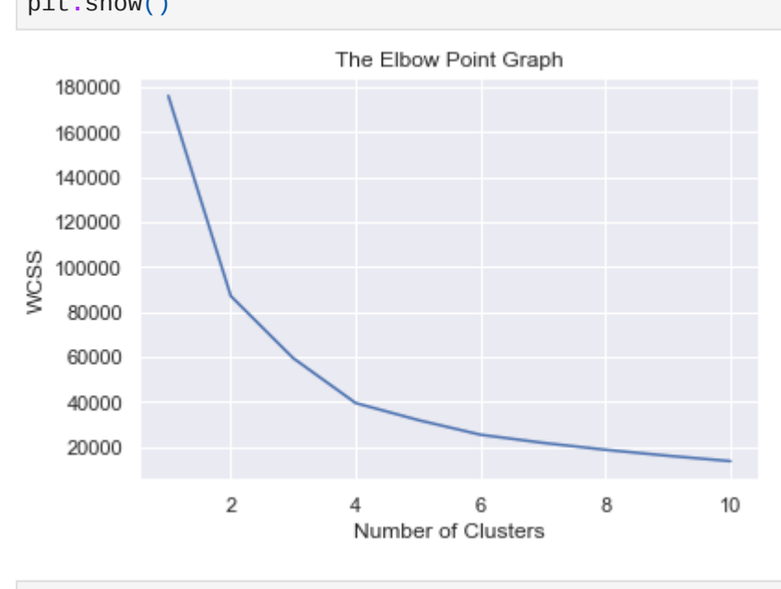
In [33]:
```python
#Visualizing the Clusters

plt.figure(figsize=(8,8))
plt.scatter(X1[Y1==0,0], X1[Y1==0,1], s=50, c='green', label='Cluster 1')
plt.scatter(X1[Y1==1,0], X1[Y1==1,1], s=50, c='red', label='Cluster 2')
plt.scatter(X1[Y1==2,0], X1[Y1==2,1], s=50, c='yellow', label='Cluster 3')
plt.scatter(X1[Y1==3,0], X1[Y1==3,1], s=50, c='violet', label='Cluster 4')
plt.scatter(X1[Y1==4,0], X1[Y1==4,1], s=50, c='blue', label='Cluster 5')

# plot the centroids
plt.scatter(kmeans.cluster_centers_[:,0], kmeans.cluster_centers_[:,1], s=100, c='cyan', label='Centroids')

plt.title('Customer type groups')
plt.xlabel('Age')
plt.ylabel('Spending Score')
plt.show()
```



In [47]:
```python
#clustering using age and spending score
X3 = df.iloc[:,[2,3]].values
wcss2 = []
for i in range(1,11):
    kmeans = KMeans(n_clusters= i , init = 'k-means++' , random_state=0)
    kmeans.fit(X3)
    wcss2.append(kmeans.inertia_)
```

```
C:\Users\Atharva Yadav\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036: UserWarning: KMeans is known to have a memory leak on Windows with MKL, when there are less chunks than available thre
ads. You can avoid it by setting the environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```

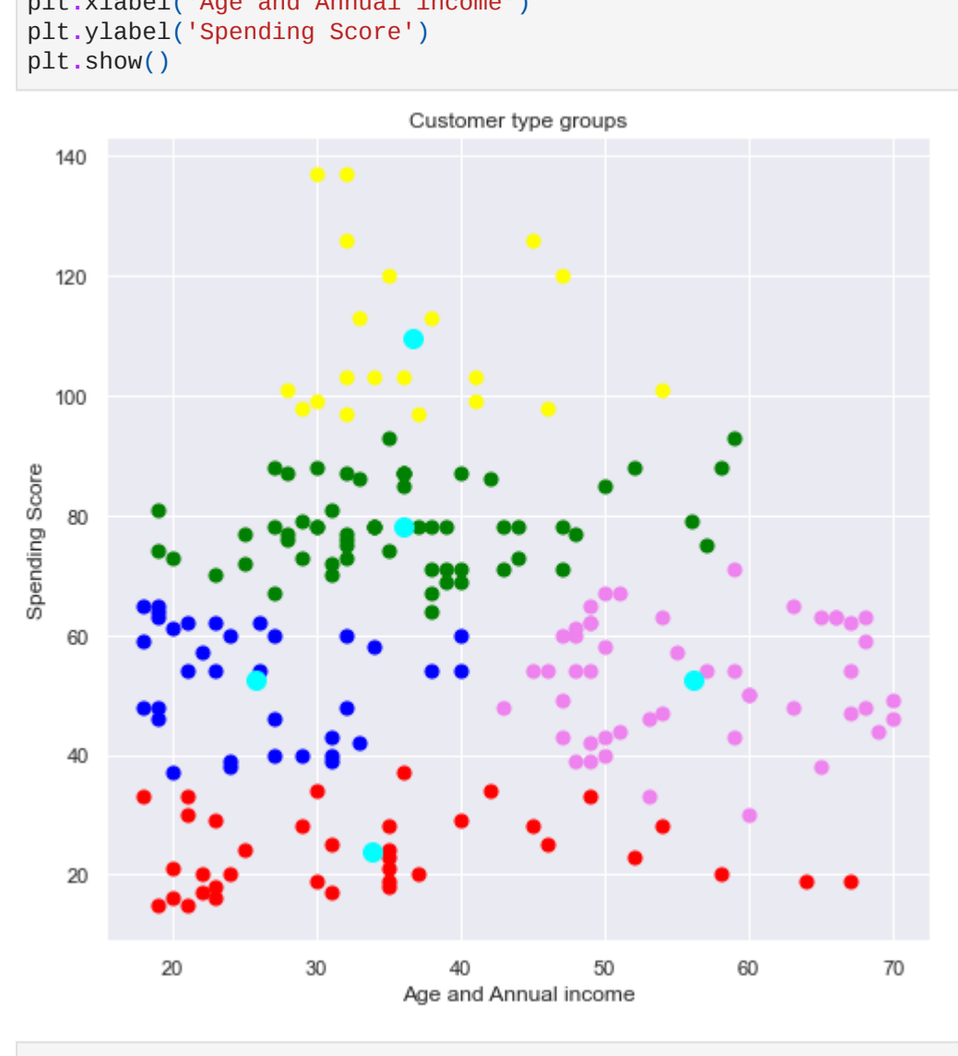
In [51]:
```python
#plotting an elbow graph

sns.set()
plt.plot(range(1,11) , wcss2)
plt.title('The Elbow Point Graph')
plt.xlabel('Number of Clusters')
plt.ylabel('WCSS')
plt.show()
```



In [52]:
```python
#Training the Kmeans Clustering Model
kmeans = KMeans(n_clusters = 5 , init = 'k-means++' , random_state=0)
Y3 = kmeans.fit_predict(X3)
print(Y3)
```

```
[1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 1 3 1 1 1
 1 1 4 3 4 3 4 3 4 3 4 4 4 3 4 4 3 3 3 3 3 4 3 3 4 3 3 3 3 4 3 3 4 4 3 3 3
 3 4 3 4 4 3 3 4 3 3 4 3 3 4 4 3 3 4 3 4 4 4 3 4 3 4 4 3 3 4 3 4 3 3 3 3 3
 4 0 4 4 4 3 3 3 3 0 0 0 0 0 0 0 0 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2]
```

In [53]:
```python
#Visualizing the Clusters

plt.figure(figsize=(8,8))
plt.scatter(X3[Y3==0,0], X3[Y3==0,1], s=50, c='green', label='Cluster 1')
plt.scatter(X3[Y3==1,0], X3[Y3==1,1], s=50, c='red', label='Cluster 2')
plt.scatter(X3[Y3==2,0], X3[Y3==2,1], s=50, c='yellow', label='Cluster 3')
plt.scatter(X3[Y3==3,0], X3[Y3==3,1], s=50, c='violet', label='Cluster 4')
plt.scatter(X3[Y3==4,0], X3[Y3==4,1], s=50, c='blue', label='Cluster 5')

# plot the centroids
plt.scatter(kmeans.cluster_centers_[:,0], kmeans.cluster_centers_[:,1], s=100, c='cyan', label='Centroids')

plt.title('Customer type groups')
plt.xlabel('Age and Annual income')
plt.ylabel('Spending Score')
plt.show()
```



In [54]:

```
  Input In [54]
    .
    ^
SyntaxError: invalid syntax
```

In [ ]: