```python
import pandas as pd
import matplotlib.pyplot as plt

df = pd.read_csv("Mall_Customers.csv")

features = ['Annual Income (k$)','Spending Score (1-100)']
X = df[features].values

from sklearn.cluster import KMeans

wcss = []
for i in range(1, 11):
    kmeans = KMeans(n_clusters=i)
    kmeans.fit(X)
    wcss.append(kmeans.inertia_)
```

```
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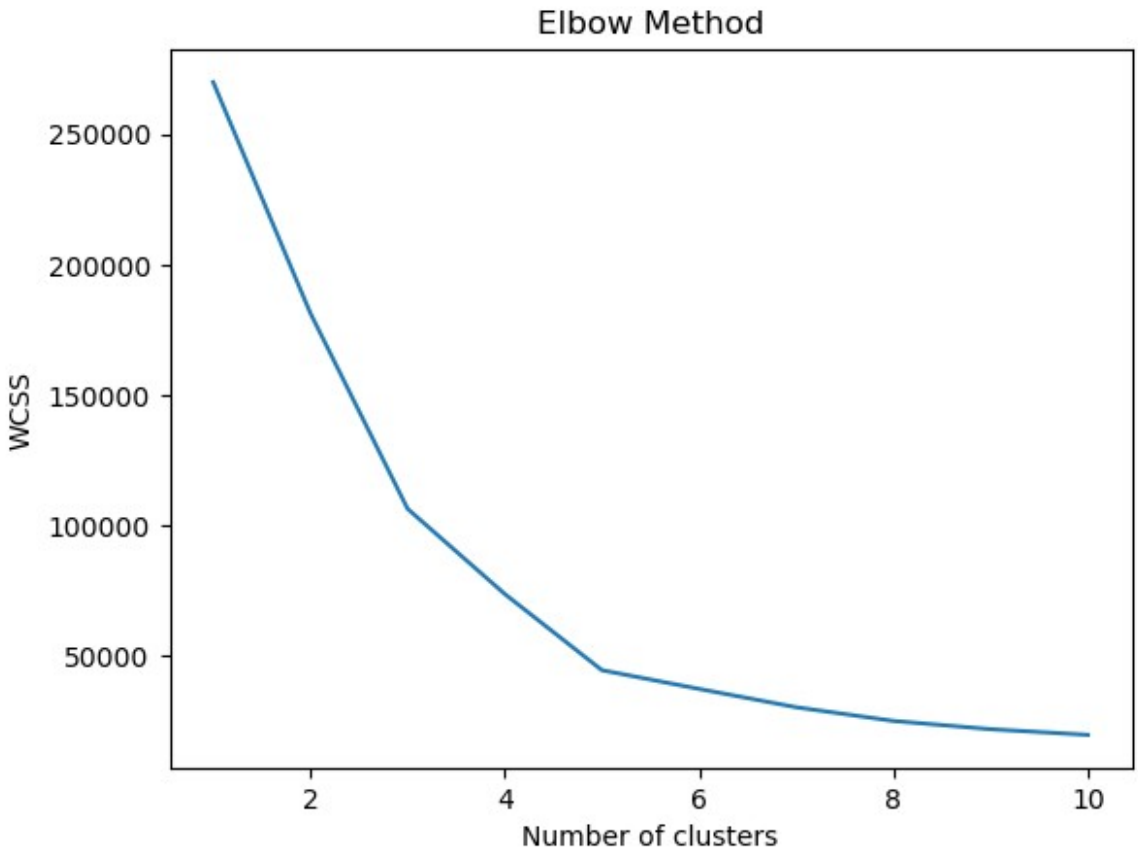
```

```
plt.plot(range(1, 11), wcss)
plt.title('Elbow Method')
plt.xlabel('Number of clusters')
plt.ylabel('WCSS')
plt.show()
```




```
kmeans = KMeans(n_clusters=5)
y_means = kmeans.fit_predict(X)
```

```
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```
for i in range(5):
    cluster_data = df[y_means == i]
    print(f"\nCluster {i+1} characteristics:")

    print(cluster_data[features].describe())
```

```
Cluster 1 characteristics:
       Annual Income (k$)  Spending Score (1-100)
```

```
count           81.000000                81.000000
mean            55.296296                49.518519
std              8.988109                 6.530909
min             39.000000                34.000000
25%             48.000000                44.000000
50%             54.000000                50.000000
75%             62.000000                55.000000
max             76.000000                61.000000

Cluster 2 characteristics:
       Annual Income (k$)  Spending Score (1-100)
count           23.000000                23.000000
mean            26.304348                20.913043
std              7.893811                13.017167
min             15.000000                 3.000000
25%             19.500000                 9.500000
50%             25.000000                17.000000
75%             33.000000                33.500000
max             39.000000                40.000000

Cluster 3 characteristics:
       Annual Income (k$)  Spending Score (1-100)
count           35.000000                35.000000
mean            88.200000                17.114286
std             16.399067                 9.952154
min             70.000000                 1.000000
25%             77.500000                10.000000
50%             85.000000                16.000000
75%             97.500000                23.500000
max            137.000000                39.000000

Cluster 4 characteristics:
       Annual Income (k$)  Spending Score (1-100)
count           39.000000                39.000000
mean            86.538462                82.128205
std             16.312485                 9.364489
min             69.000000                63.000000
25%             75.500000                74.500000
50%             79.000000                83.000000
75%             95.000000                90.000000
max            137.000000                97.000000

Cluster 5 characteristics:
       Annual Income (k$)  Spending Score (1-100)
count           22.000000                22.000000
mean            25.727273                79.363636
std              7.566731                10.504174
min             15.000000                61.000000
25%             19.250000                73.000000
50%             24.500000                77.000000
```

```
75%                 32.250000                 85.750000
max                 39.000000                 99.000000
```

```
plt.scatter(X[y_means == 0,0],X[y_means ==
0,1],color='blue',label='Cluster 1')
plt.scatter(X[y_means == 1,0],X[y_means ==
1,1],color='pink',label='Cluster 2')


centroids = kmeans.cluster_centers_


plt.scatter(centroids[0, 0], centroids[0, 1], marker='*',
color='yellow', label='Centroid 1')
plt.scatter(centroids[1, 0], centroids[1, 1], marker='*',
color='yellow', label='Centroid 2')

plt.title('Clusters of customers')
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.legend()
plt.show()
```

```
df["Target"]=y_means

Clustered_df=df
Clustered_df.head()
```

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

```
X=Clustered_df.iloc[:,1:5]
y=Clustered_df.iloc[:,-1]

y.head()
```

```
0    1
1    4
2    1
3    4
4    1
Name: Target, dtype: int32
```

```
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder, StandardScaler

le=LabelEncoder()
X['Gender'] = le.fit_transform(X['Gender'])

X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)

sc=StandardScaler()
X_train=sc.fit_transform(X_train)
X_test=sc.transform(X_test)

from sklearn.ensemble import GradientBoostingClassifier
from sklearn.metrics import accuracy_score

gbdt = GradientBoostingClassifier(n_estimators=50,random_state=2)

gbdt.fit(X_train,y_train)
y_pred=gbdt.predict(X_test)
accuracy = accuracy_score(y_test, y_pred)
accuracy
```

```
0.975
```

```
y_pred=gbdt.predict(X_test)
y_pred
```

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

```
prediction = pd.DataFrame({'Original Value': y_test, 'Predicted
Value': y_pred})

display(prediction)
```

	Original Value	Predicted Value
95	0	0
15	4	4
30	1	1
158	2	2
128	2	2
115	0	0
69	0	0
170	2	2
174	2	2
45	4	0
66	0	0
182	2	2
165	3	3
78	0	0
186	2	2
177	3	3
56	0	0
152	2	2
82	0	0
68	0	0
124	2	2
16	1	1
148	2	2
93	0	0
65	0	0
60	0	0
84	0	0
67	0	0
125	3	3
132	0	0
9	4	4
18	1	1
55	0	0
75	0	0
150	2	2

```
104                 0                 0
135                 3                 3
137                 3                 3
164                 2                 2
76                  0                 0
```