

```
import pandas as pd
import numpy as np
import numpy.random as rd
import seaborn as sns
import matplotlib.pyplot as plt

df = pd.read_csv("Mall_Customers.csv", index_col=0)
df = pd.DataFrame(df)
df
```

📄

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

200 rows × 4 columns

```
df.isna().sum()

Genre      0
Age        0
Annual Income (k$)  0
Spending Score (1-100)  0
dtype: int64
```

```
df["Genre"].replace({"Male" : 1, "Female" : 0}, inplace=True)
df
```

📄

	Genre	Age	Annual Income (k\$)	Spending Score (1-100)
CustomerID				
1	1	19	15	39
2	1	21	15	81
3	0	20	16	6
4	0	23	16	77
5	0	31	17	40
...	...	...	...	...
196	0	35	120	79
197	0	45	126	28
198	1	32	126	74
199	1	32	137	18
200	1	30	137	83

200 rows × 4 columns

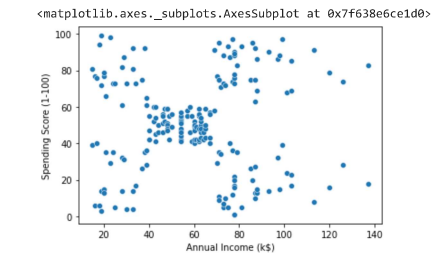
```
df1 = df[["Annual Income (k$)", "Spending Score (1-100)"]]
df1
```

📄

	Annual Income (k\$)	Spending Score (1-100)
CustomerID		
1	15	39
2	15	81
3	16	6
4	16	77
5	17	40
...	...	...
196	120	79
197	126	28
198	126	74
199	137	18
200	137	83

200 rows × 2 columns

```
sns.scatterplot(data=df1, x="Annual Income (k$)", y="Spending Score (1-100)")
```

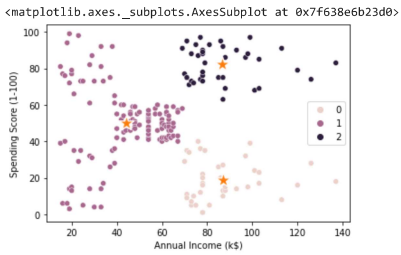


```
from sklearn.cluster import KMeans

kmeans = KMeans(n_clusters=3, random_state=0, init="k-means++").fit(df1)
colors=kmeans.labels_
```

```
cluster_centers = kmeans.cluster_centers_
cluster_centers
t = [itm[0] for itm in cluster_centers]
p = [itm[1] for itm in cluster_centers]
```

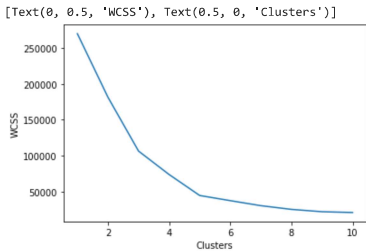
```
sns.scatterplot(data=df1, x="Annual Income (k$)", y="Spending Score (1-100)", hue=colors)
sns.scatterplot(x=t, y=p, marker='*', s=300)
```



```
wcss = []
for i in range(1, 11):
    kmeans = KMeans(n_clusters=i, random_state = 0, init="k-means++").fit(df1)
    wcss.append(kmeans.inertia_)
wcss
```

```
[269981.28,
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25095.70320999756,
21830.041978049434,
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```

```
sns.lineplot(x=[i for i in range(1, 11)], y=wcss).set(xlabel="Clusters", ylabel="WCSS")
```



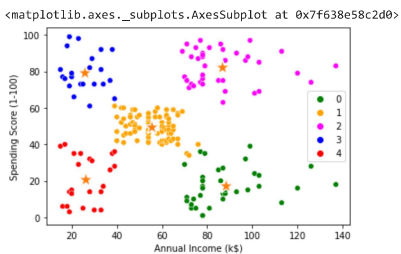
```
kmeans = KMeans(n_clusters=5, random_state=0, init="k-means++").fit(df1)
colors=kmeans.labels_
```

```
cluster_centers = kmeans.cluster_centers_
x, y = [], []
for itm in cluster_centers:
    x.append(itm[0])
    y.append(itm[1])
```

```
x, y

([88.20000000000002,
55.29629629629632,
86.53846153846155,
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26.304347826086982],
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82.12820512820511,
79.36363636363636,
20.913043478260867])
```

```
sns.scatterplot(data=df1, x="Annual Income (k$)", y="Spending Score (1-100)", hue=colors,palette=['green','orange','magenta','blue','red'])
sns.scatterplot(x=x, y=y, marker='*', s=300)
```



```
import scipy.cluster.hierarchy as sch
sch.dendrogram(sch.linkage(df1, method='ward'))
```

```
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[illegible]

400

```
clustering = AgglomerativeClustering(n_clusters=5).fit(df1)
cluster_centers = kmeans.cluster_centers_
x, y = [], []
for itm in cluster_centers:
    x.append(itm[0])
    y.append(itm[1])
```

x. v

```
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```

```
sns.scatterplot(data=df1, x="Annual Income (k$)", y="Spending Score (1-100)", hue=clustering.labels_,palette=['green','orange','magenta','blue','red'])  
sns.scatterplot(x=x, y=y, marker='*', s=300)
```

