

```
In [1]: import pandas as pd  
import matplotlib.pyplot as plt
```

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

```
In [3]: df
```

```
Out[3]: CustomerID  Genre  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
...	...	...	...	...	...
195	196	Female	35	120	79
196	197	Female	45	126	28
197	198	Male	32	126	74
198	199	Male	32	137	18
199	200	Male	30	137	83

200 rows × 5 columns

```
In [6]: x = df.iloc[:,3:]  
x
```

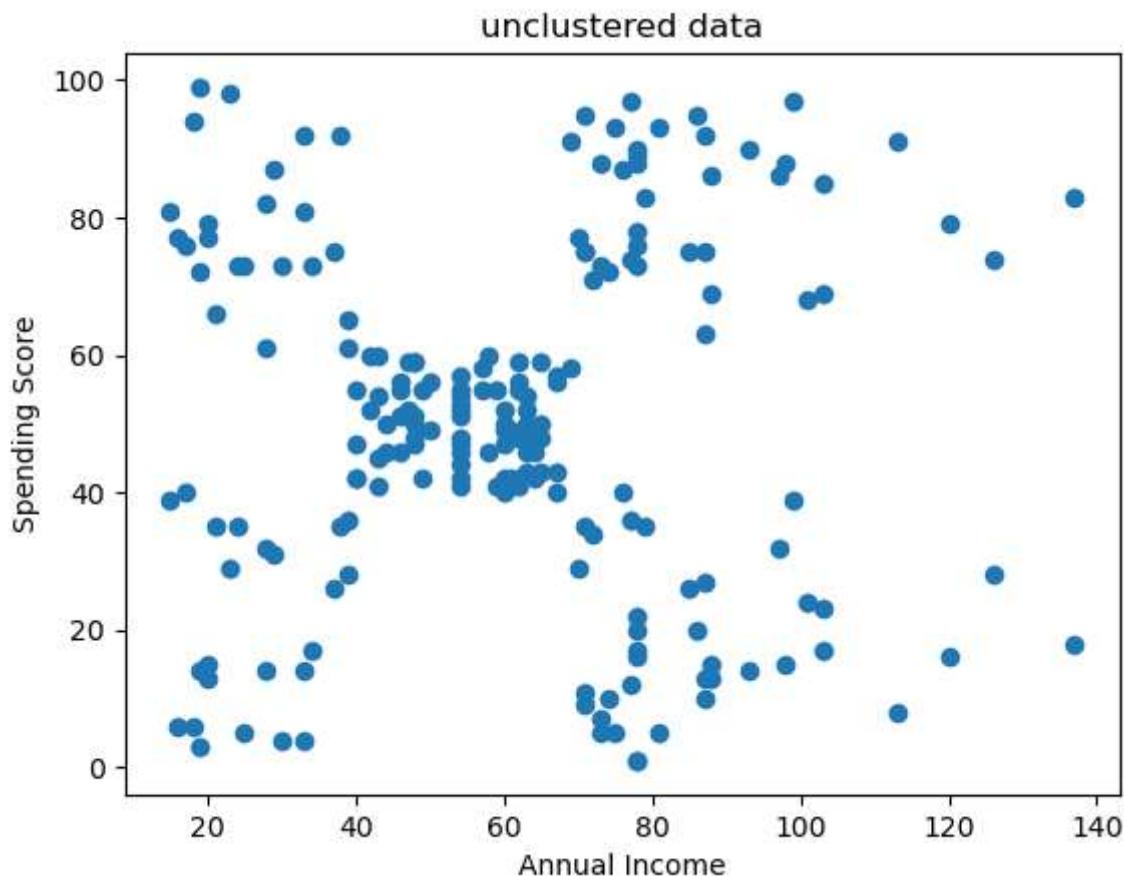
Out[6]:

	Annual Income (k\$)	Spending Score (1-100)
0	15	39
1	15	81
2	16	6
3	16	77
4	17	40
...	...	...
195	120	79
196	126	28
197	126	74
198	137	18
199	137	83

200 rows × 2 columns

```
In [8]: plt.title('unclustered data')
plt.xlabel('Annual Income')
plt.ylabel('Spending Score')
plt.scatter(x['Annual Income (k$)'], x['Spending Score (1-100)'])
```

Out[8]: &lt;matplotlib.collections.PathCollection at 0x1e6e28a1f50&gt;



```
In [9]: from sklearn.cluster import KMeans, AgglomerativeClustering
```

```
In [10]: km = KMeans(n_clusters=6)
```

```
In [11]: km.fit_predict(x)
```

```
C:\Users\omnic\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
    warnings.warn(
C:\Users\omnic\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on Windows with MKL, when there are less chunks than available threads. You can avoid it by setting the environment variable OMP_NUM_THREADS=1.
    warnings.warn(
```

```
Out[11]: array([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, 3, 4,
   3, 4, 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, 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,
   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, 5, 0, 5, 0, 5, 0, 5, 0, 5, 0, 5, 0, 5, 0, 5, 0, 5, 0, 5, 0, 5,
```

```
In [12]: #SSE
km.inertia_
```

```
Out[12]: 37239.83554245604
```

```
In [13]: sse = []
for k in range (1,16):
    km = KMeans(n_clusters=k)
    km.fit_predict(x)
    sse.append(km.inertia_)
```

```
C:\Users\omnic\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
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```
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    warnings.warn(
```

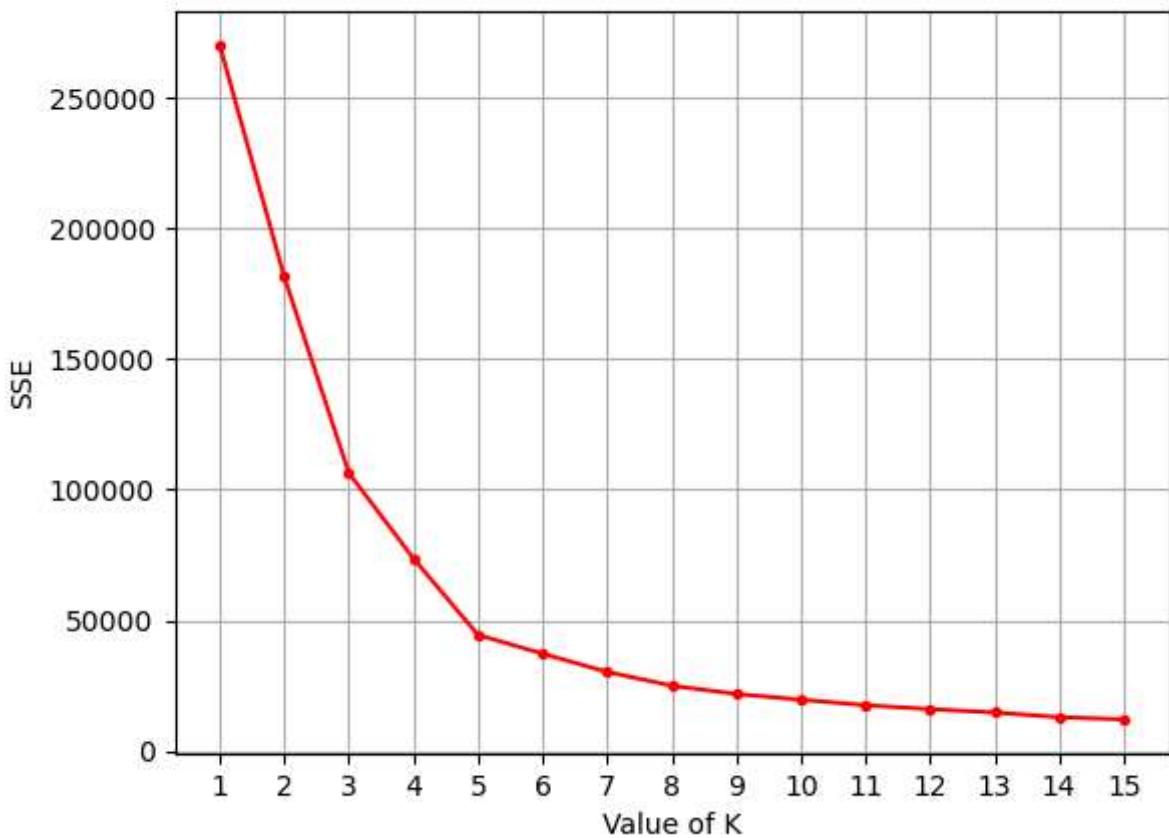
In [14]: sse

Out[14]: [269981.28,  
181363.595959596,  
106348.37306211119,  
73679.78903948837,  
44448.45544793371,  
37265.86520484347,  
30259.65720728547,  
25018.78161341407,  
21838.86369282891,  
19676.612585602805,  
17546.928000046548,  
16056.615737203974,  
14784.095573309896,  
12973.056460206462,  
12136.223022445392]

In [16]: plt.title('Elbow Method')  
plt.xlabel('Value of K')  
plt.ylabel('SSE')  
plt.grid()  
plt.xticks(range(1,16))  
plt.plot(range(1,16), sse, marker='.', color='red')

Out[16]: [`matplotlib.lines.Line2D at 0x1e6ede04910`]

### Elbow Method



```
In [17]: from sklearn.metrics import silhouette_score
```

```
In [19]: silh = []
for k in range (2,16):
    km = KMeans(n_clusters=k)
    labels = km.fit_predict(x)
    score = silhouette_score(x, labels)
    silh.append(score)
```

```
C:\Users\omnic\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
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C:\Users\omnic\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
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```
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```

```
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C:\Users\omnic\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1382: UserWarning:  
      KMeans is known to have a memory leak on Windows with MKL, when there are less ch  
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_NUM_THREADS=1.  
    warnings.warn(
```

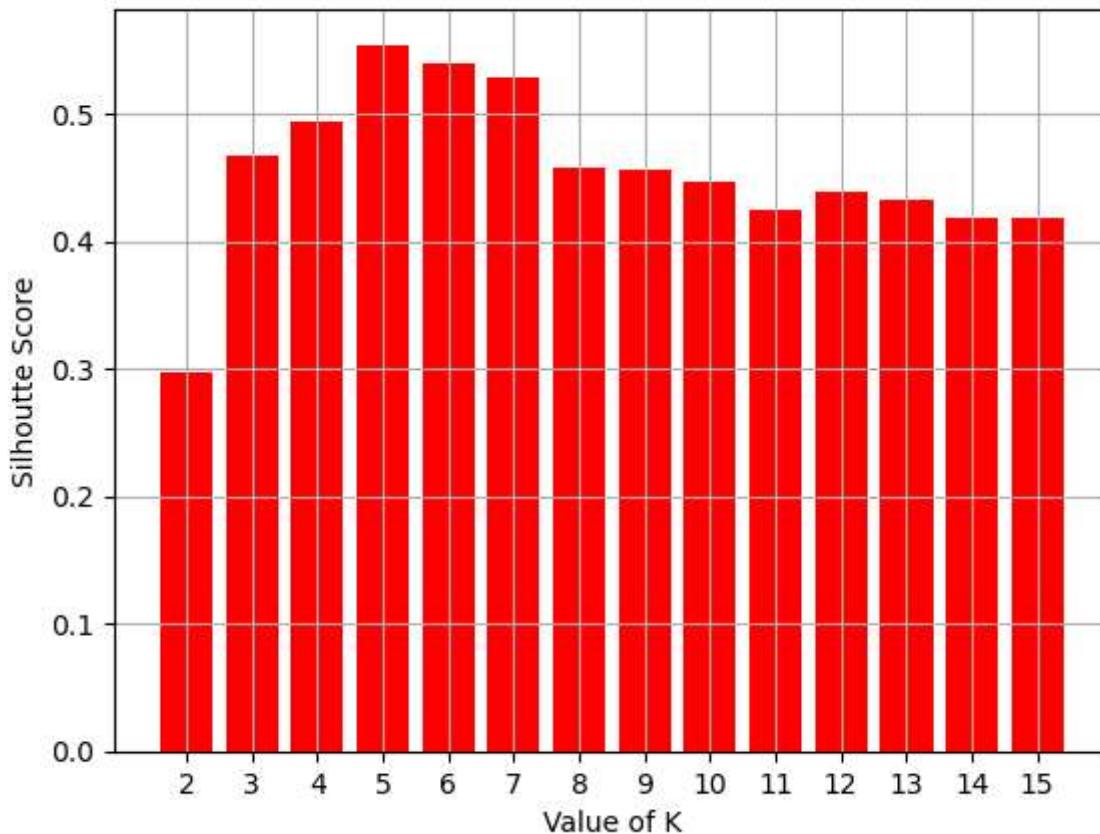
In [20]: silh

```
Out[20]: [0.2968969162503008,  
 0.46761358158775435,  
 0.4931963109249047,  
 0.553931997444648,  
 0.5393922132561455,  
 0.5288104473798049,  
 0.4581763522413715,  
 0.4565077334305076,  
 0.44633129910767944,  
 0.4247079717069671,  
 0.4386071394328943,  
 0.4319868737519759,  
 0.41755043645168427,  
 0.41741302478473136]
```

```
In [21]: plt.title('Silhouette Method')  
plt.xlabel('Value of K')  
plt.ylabel('Silhouette Score')  
plt.grid()  
plt.xticks(range(2,16))  
plt.bar(range(2,16), silh, color='red')
```

Out[21]: <BarContainer object of 14 artists>

## Silhouette Method



```
In [22]: km = KMeans(n_clusters=5, random_state=0)
```

In [ ]:

```
In [25]: labels=km.fit_predict(x)
          labels
```

C:\Users\omnic\anaconda3\Lib\site-packages\sklearn\cluster\\_kmeans.py:870: FutureWarning: The default value of `n\_init` will change from 10 to 'auto' in 1.4. Set the value of `n\_init` explicitly to suppress the warning

```
warnings.warn(
```

```
C:\Users\omnic\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1382: UserWarning:  
  KMeans is known to have a memory leak on Windows with MKL, when there are less  
  chunks than available threads. You can avoid it by setting the environment variable  
  OMP_NUM_THREADS=1.
```

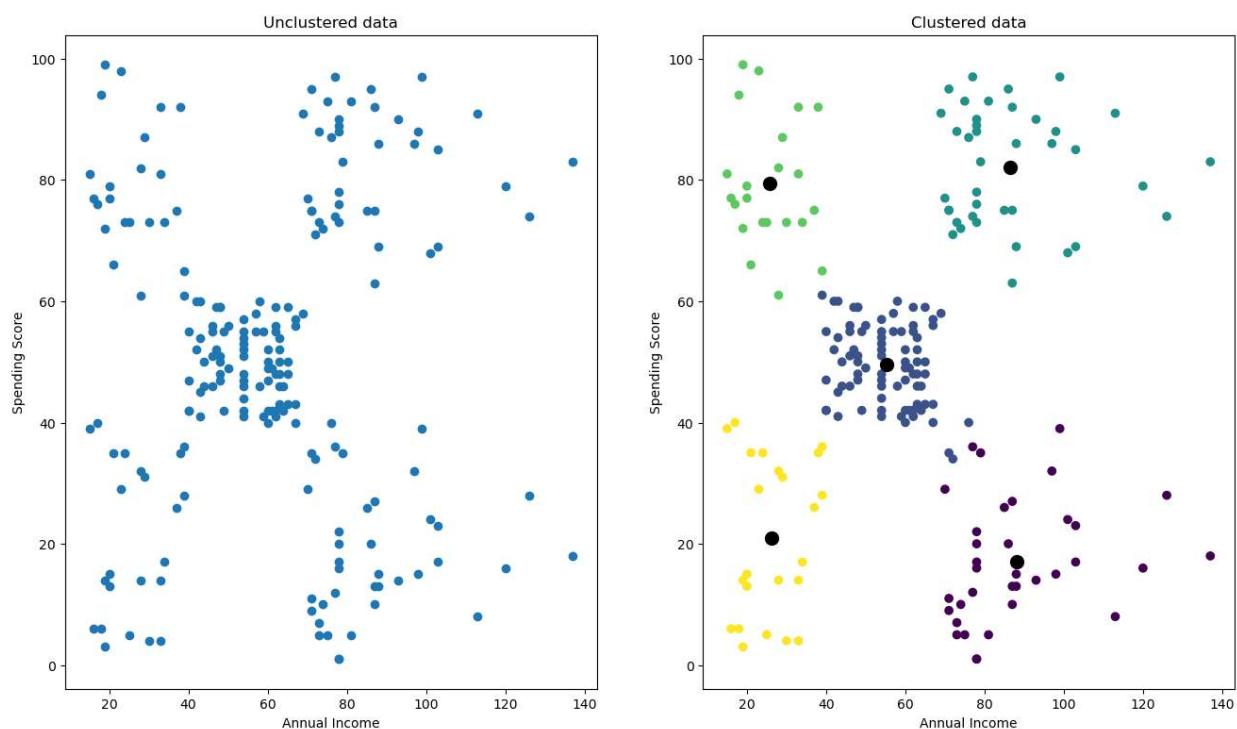
```
_WELL_WARNS_E_
```

```
In [27]: cent = km.cluster_centers_
```

```
In [29]: plt.figure(figsize=(16,9))
plt.subplot(1,2,1)
plt.title('Unclustered data')
plt.xlabel('Annual Income')
plt.ylabel('Spending Score')
plt.scatter(x['Annual Income (k$)'], x['Spending Score (1-100)'])

plt.subplot(1,2,2)
plt.title('Clustered data')
plt.xlabel('Annual Income')
plt.ylabel('Spending Score')
plt.scatter(x['Annual Income (k$)'], x['Spending Score (1-100)'], c=labels)
plt.scatter(cent[:,0], cent[:,1], s=100, color='k')
```

Out[29]: <matplotlib.collections.PathCollection at 0x1e6ee5c84d0>



```
In [30]: km.inertia_
```

```
Out[30]: 44448.45544793371
```

In [31]: `km.labels`

```
In [32]: df[labels == 4]
```

Out[32]:

	CustomerID	Genre	Age	Annual Income (k\$)	Spending Score (1-100)
0	1	Male	19	15	39
2	3	Female	20	16	6
4	5	Female	31	17	40
6	7	Female	35	18	6
8	9	Male	64	19	3
10	11	Male	67	19	14
12	13	Female	58	20	15
14	15	Male	37	20	13
16	17	Female	35	21	35
18	19	Male	52	23	29
20	21	Male	35	24	35
22	23	Female	46	25	5
24	25	Female	54	28	14
26	27	Female	45	28	32
28	29	Female	40	29	31
30	31	Male	60	30	4
32	33	Male	53	33	4
34	35	Female	49	33	14
36	37	Female	42	34	17
38	39	Female	36	37	26
40	41	Female	65	38	35
42	43	Male	48	39	36
44	45	Female	49	39	28

In [33]:

```
four = df[labels==4]
four.to_csv('mydata.csv')
```

In [34]:

```
km.predict([[46,78]])
```

C:\Users\omnic\anaconda3\Lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature names, but KMeans was fitted with feature names  
warnings.warn(

Out[34]:

```
array([3])
```

In [35]:

```
agl = AgglomerativeClustering(n_clusters=5)
```

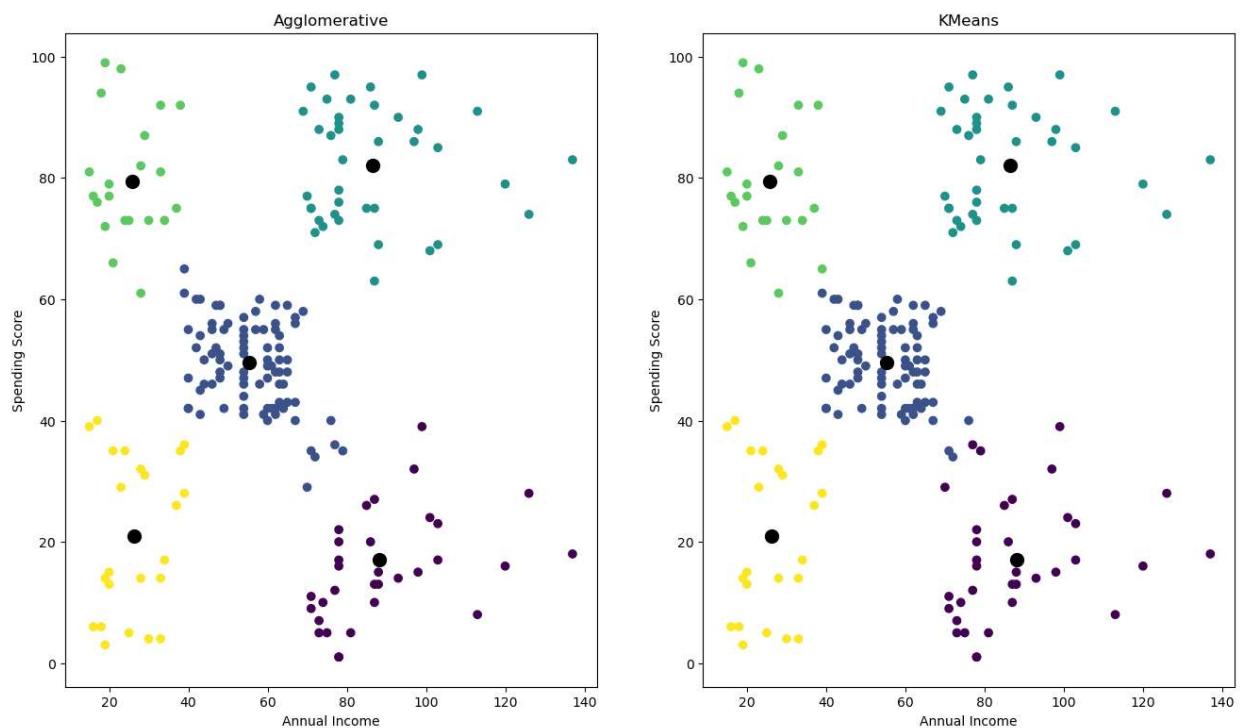
In [36]:

```
alabels = agl.fit_predict(x)
```

```
In [37]: plt.figure(figsize=(16,9))
plt.subplot(1,2,1)
plt.title('Agglomerative')
plt.xlabel('Annual Income')
plt.ylabel('Spending Score')
plt.scatter(x['Annual Income (k$)'], x['Spending Score (1-100)'], c=alabels)
plt.scatter(cent[:,0], cent[:,1], s=100, color='k')

plt.subplot(1,2,2)
plt.title('KMeans')
plt.xlabel('Annual Income')
plt.ylabel('Spending Score')
plt.scatter(x['Annual Income (k$)'], x['Spending Score (1-100)'], c=labels)
plt.scatter(cent[:,0], cent[:,1], s=100, color='k')
```

```
Out[37]: <matplotlib.collections.PathCollection at 0x1e6ef5f2810>
```



```
In [ ]:
```