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Class : TE IT B
Roll No :- 37020

In [42]:
```
import pandas as pd
import matplotlib.pyplot as plt

import os
os.environ["OMP_NUM_THREADS"] = "1"
```

In [43]:
```
import sklearn
```

In [4]:
```
df= pd.read_csv("Mall_customers.csv")
```

In [5]:
```
df.head()
```

Out[5]:

	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

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

In [7]:
```
x
```

Out[7]:

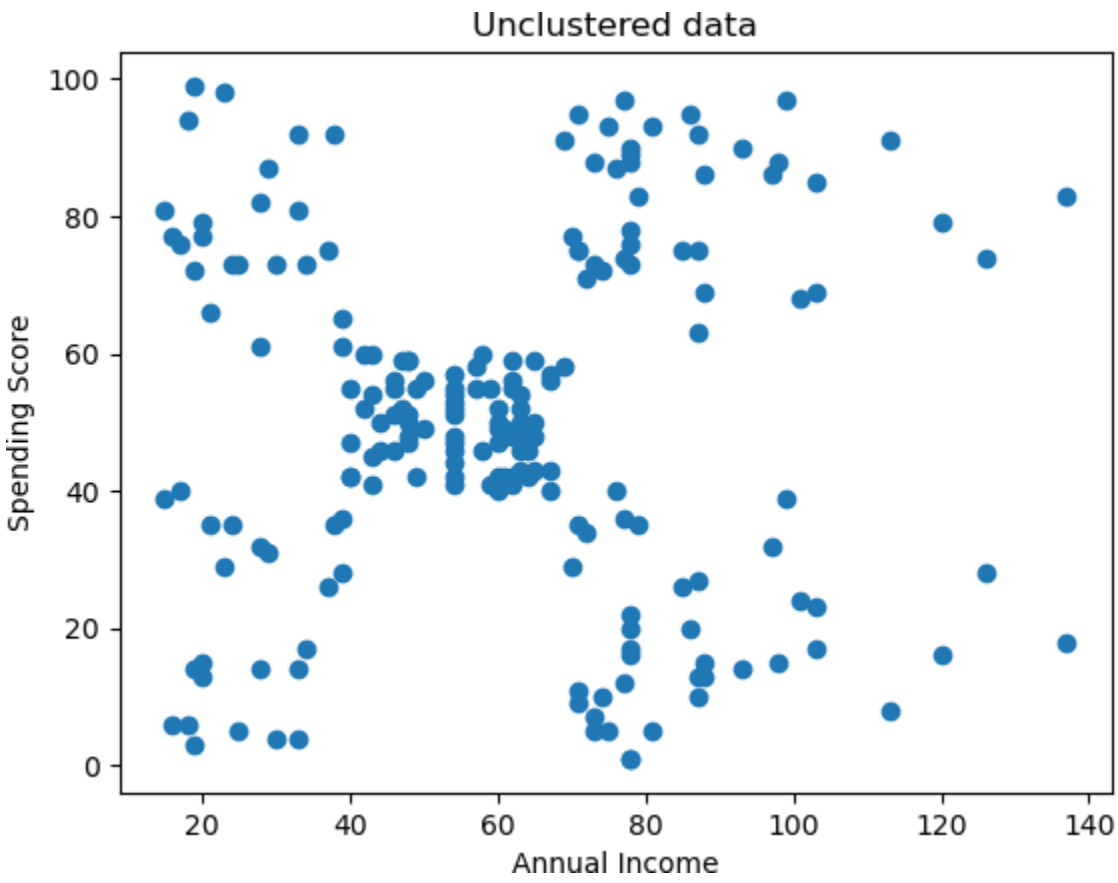
	Annual Income (k$)	Spending Score (1-100)
0	15	39
1	15	81
2	16	6
3	16	77
4	17	40
...	...	...
195	120	79
196	126	28
197	126	74

198	137	18
199	137	83

200 rows × 2 columns

In [14]:
```
plt.title("Unclustered data")
plt.xlabel("Annual Income")
plt.ylabel("Spending Score")
plt.scatter(x['Annual Income (k$)'], x['Spending Score (1-100)'])
```

Out[14]: <matplotlib.collections.PathCollection at 0x20f3a12b4d0>



In [16]:
```
from sklearn.cluster import KMeans,AgglomerativeClustering
```

In [25]:
```
km = KMeans(n_clusters=6)
```

In [22]:
```
x.shape
```

Out[22]: (200, 2)

In [26]:
```
km.fit_predict(x)
```

```
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1419: UserWarn
ing: 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[26]:
```
array([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, 1, 3, 1, 1,
       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, 5, 1, 1, 5, 1, 1, 1, 1, 1,
       1, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 0, 5, 0, 5, 0, 2, 0, 2, 0,
       5, 0, 2, 0, 2, 0, 2, 0, 2, 0, 5, 0, 2, 0, 5, 0, 2, 0, 2, 0, 2, 0,
       2, 0, 2, 0, 2, 0, 5, 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], dtype=int32)
```

In [28]:
```
#Sum Squered Error SSE
km.inertia_
```

Out[28]:
```
38788.45862332112
```

In [32]:
```
sse =[]
for k in range(1,16):
  km = KMeans(n_clusters=k)
  km.fit_predict(x)
  sse.append(km.inertia_)
```

```
:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1419: UserWarn
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```
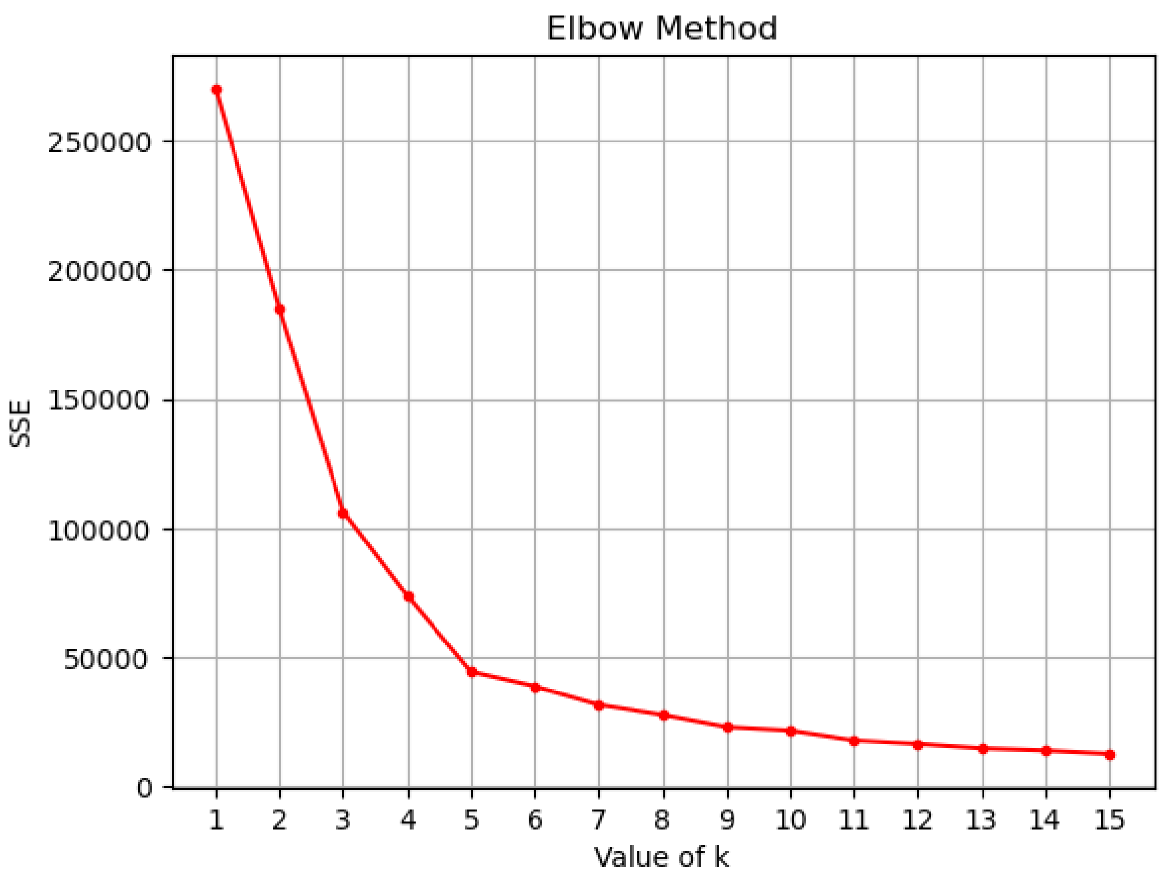

In [33]:

```python
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[33]:

```
[<matplotlib.lines.Line2D at 0x20f3e523750>]
```



In [40]:
```
from sklearn.metrics import silhouette_score
```

In [41]:
```
silh =[]
for k in range(2,16):
  km = KMeans(n_clusters=k)
  label = km.fit_predict(x)
  score= silhouette_score(x,label)
  silh.append(score)
```

```
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1419: UserWarn
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```

```
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chunks than available threads. You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
```
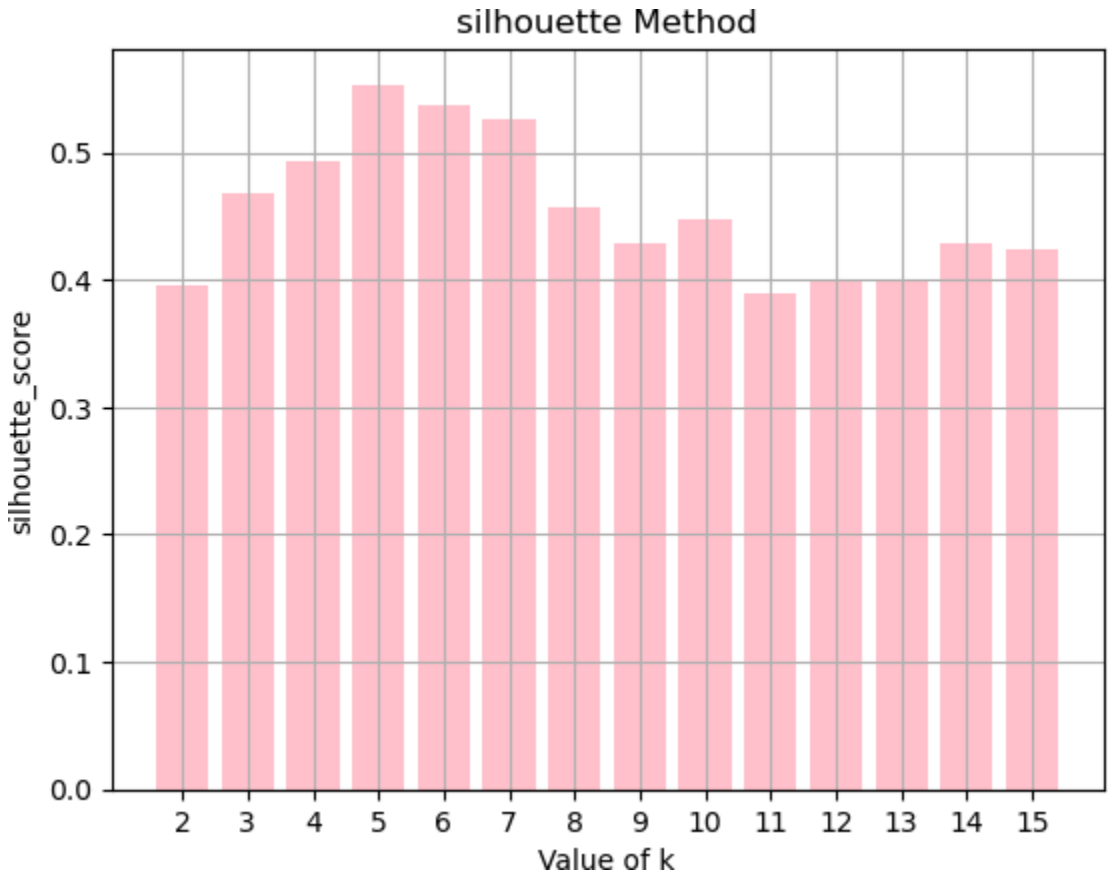

In [44]:
```
silh
```

Out[44]:
```
[np.float64(0.39564531743995546),
 np.float64(0.46761358158775435),
 np.float64(0.4937945814354117),
 np.float64(0.5532176107575425),
 np.float64(0.5376203956398481),
 np.float64(0.5264283703685728),
 np.float64(0.45673055353191067),
 np.float64(0.42793901630914255),
 np.float64(0.4477405371237999),
 np.float64(0.3892909675700459),
 np.float64(0.4001255125716587),
 np.float64(0.40041862117336813),
 np.float64(0.4287654751715641),
 np.float64(0.42466594811416686)]
```

In [47]:
```
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='pink')
```

Out[47]:
```
<BarContainer object of 14 artists>
```



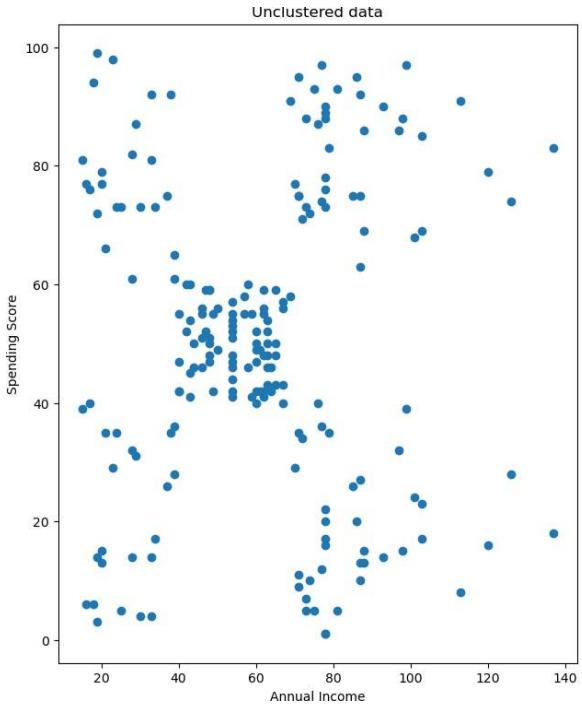
In [48]:
```
km = KMeans(n_clusters=5)
```

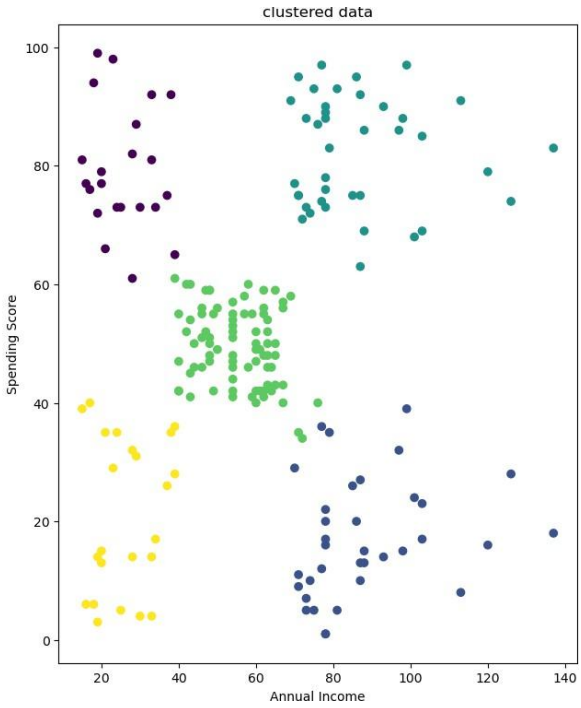
In [49]:
```
labels = km.fit_predict(x)
```

```
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1419: UserWarn
ing: 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(
```

In [51]:
```
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)
```

Out[51]:
```
<matplotlib.collections.PathCollection at 0x20f40e65950>
```


Unclustered data
Spending Score
Annual Income
0
20
40
60
80
100
20
40
60
80
100
120
140


clustered data
Spending Score
Annual Income
0
20
40
60
80
100
20
40
60
80
100
120
140