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

```
df = pd.read_csv('Mall_Customers.csv')
```

```
df
```

	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

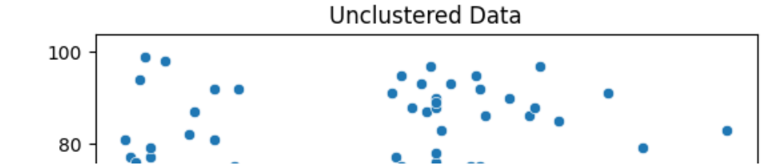
```
x = df.iloc[:,3:]
x
```

	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

```
plt.title('Unclustered Data')
sns.scatterplot(x=x['Annual Income (k$)'],y=x['Spending Score (1-100)'])
```

```
<Axes: title={'center': 'Unclustered Data'}, xlabel='Annual Income (k$)', ylabel='Spending Score (1-100)'>
```




```
from sklearn.cluster import KMeans, AgglomerativeClustering
```

```
km = KMeans(n_clusters=4)
km.fit_predict(x)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
array([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, 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, 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, 1, 3, 1, 3, 1, 3, 1, 3, 1,
       3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1,
       3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1,
       3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1,
       3, 1], dtype=int32)
```

```
km.inertia_
```

```
73679.78903948836
```

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

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
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/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
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  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
[269981.28,
 181363.59595959593,
 106348.37306211122,
 73679.78903948836,
 44448.4554479337,
 37265.86520484346,
 30273.394312070042,
 25061.304119069326,
 21916.79478984373,
 19657.78360870395,
 17508.97057740007,
 16056.61573720397,
 14544.620257057879,
 13184.888261979566,
 12302.700177763412]
```
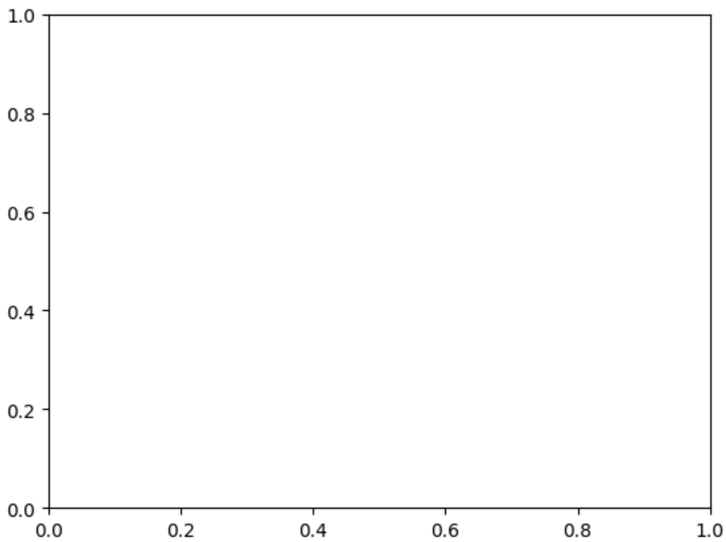

Elbow Method

```
sns.lineplot(range(1,16),y = sse)
plt.xlabel('Cluster')
plt.ylabel('SSE')
```

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
/usr/local/lib/python3.10/dist-packages/pandas/core/indexes/base.py in get_loc(self, key, method, tolerance)
   3801             try:
-> 3802                 return self._engine.get_loc(casted_key)
   3803             except KeyError as err:

                                6 frames
pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.PyObjectHashTable.get_item()

pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.PyObjectHashTable.get_item()

KeyError: 'x'

The above exception was the direct cause of the following exception:

KeyError                                  Traceback (most recent call last)
/usr/local/lib/python3.10/dist-packages/pandas/core/indexes/base.py in get_loc(self, key, method, tolerance)
   3802                 return self._engine.get_loc(casted_key)
   3803             except KeyError as err:
-> 3804                 raise KeyError(key) from err
   3805             except TypeError:
   3806                 # If we have a listlike key, _check_indexing_error will raise

KeyError: 'x'
```

SEARCH STACK OVERFLOW




```
#Method second or alternative for elbow method
from sklearn.metrics import silhouette_score
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)
silh
```

```
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  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
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  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
```

```
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  warnings.warn(
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  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
[0.2918426367691145,
 0.46761358158775435,
 0.4931963109249047,
 0.553931997444648,
 0.53976103063432,
 0.5264283703685728,
 0.45827056882053113,
 0.4565077334305076,
 0.449795408266166,
 0.44975879378781536,
 0.4408028820184285,
 0.42937323716897535,
 0.4076103387818516,
 0.42396335109319705]
```

```
sns.lineplot(range(2,16),y = silh)
plt.xlabel('Cluster')
plt.ylabel('silh')
```

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
/usr/local/lib/python3.10/dist-packages/pandas/core/indexes/base.py in get_loc(self, key, method, tolerance)
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-> 3802                 return self._engine.get_loc(casted_key)
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KeyError: 'x'
```
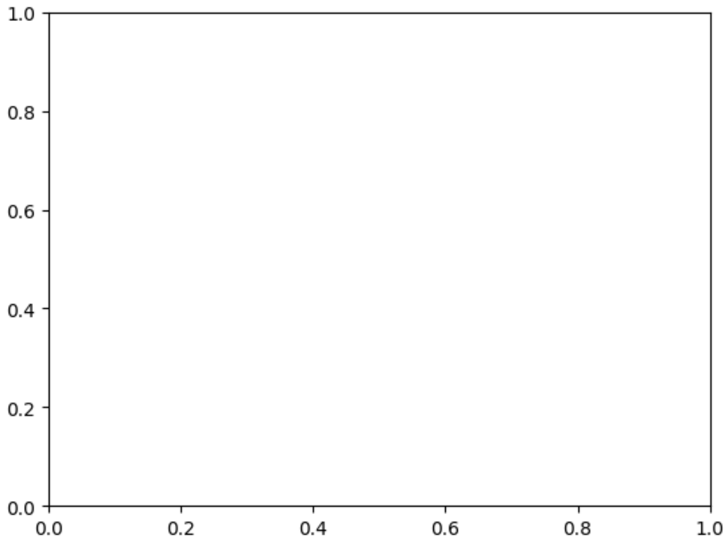
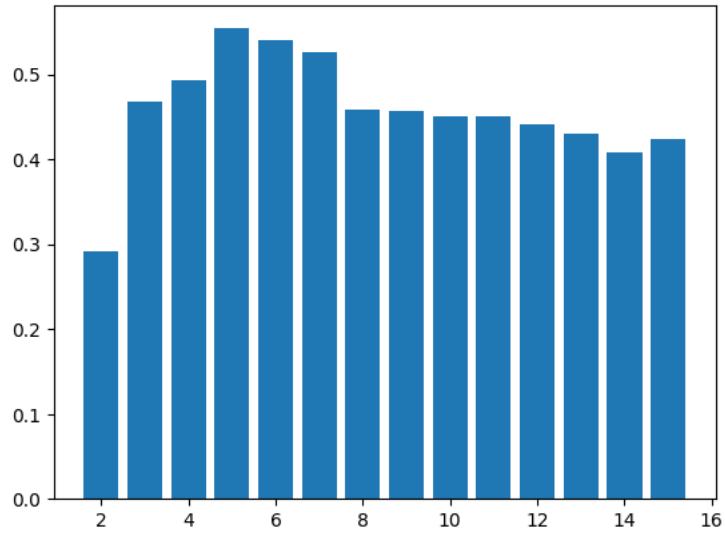

SEARCH STACK OVERFLOW



```
plt.bar(range(2,16,1),silh)
```

```
<BarContainer object of 14 artists>
```




```
km = KMeans(n_clusters=5,random_state=1)
labels = km.fit_predict(x)
km.labels_
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
array([4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0,
       4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 2,
       4, 0, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 1, 3, 2, 3, 1, 3, 1, 3,
       2, 3, 1, 3, 1, 3, 1, 3, 1, 3, 2, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3,
       1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3,
       1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3,
       1, 3], dtype=int32)
```

```
cent = km.cluster_centers_
plt.title('Clustered Data')
sns.scatterplot(x=x['Annual Income (k$)'],y=x['Spending Score (1-100)'],c=labels )
sns.scatterplot(cent[:,0],cent[:,1], s=200, color='red')
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
```

```
df[labels==0]
```

	CustomerID	Genre	Age	Annual Income (k$)	Spending Score (1-100)
1	2	Male	21	15	81
3	4	Female	23	16	77
5	6	Female	22	17	76
7	8	Female	23	18	94
9	10	Female	30	19	72
11	12	Female	35	19	99
13	14	Female	24	20	77
15	16	Male	22	20	79
17	18	Male	20	21	66
19	20	Female	35	23	98
21	22	Male	25	24	73
23	24	Male	31	25	73
25	26	Male	29	28	82
27	28	Male	35	28	61
29	30	Female	23	29	87
31	32	Female	21	30	73
33	34	Male	18	33	92
35	36	Female	21	33	81
37	38	Female	30	34	73
39	40	Female	20	37	75
41	42	Male	24	38	92
45	46	Female	24	39	65

```
agl = AgglomerativeClustering(n_clusters=5)
alabels = agl.fit_predict(x)
alabels
```

```
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, 4, 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, 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, 1, 2, 1, 2, 0, 2, 0, 2,
       1, 2, 0, 2, 0, 2, 0, 2, 0, 2, 1, 2, 0, 2, 1, 2, 0, 2, 0, 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])
```

```
plt.figure(figsize=(16,9))
plt.subplot(1,2,1)
plt.title('Agglomerative')
sns.scatterplot(x=x['Annual Income (k$)'],y=x['Spending Score (1-100)'], c= alabels)

plt.subplot(1,2,2)
plt.title('KMEANS')
sns.scatterplot(x=x['Annual Income (k$)'],y=x['Spending Score (1-100)'],c=labels )
sns.scatterplot(cent[:,0],cent[:,1], s=200, color='red')
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-35-af8f067b64c1> in <cell line: 9>()
      7 plt.title('KMEANS')
      8 sns.scatterplot(x=x['Annual Income (k$)'],y=x['Spending Score (1-100)'],c=labels )
----> 9 sns.scatterplot(cent[:,0],cent[:,1], s=200, color='red')

TypeError: scatterplot() takes from 0 to 1 positional arguments but 2 were given
```

SEARCH STACK OVERFLOW