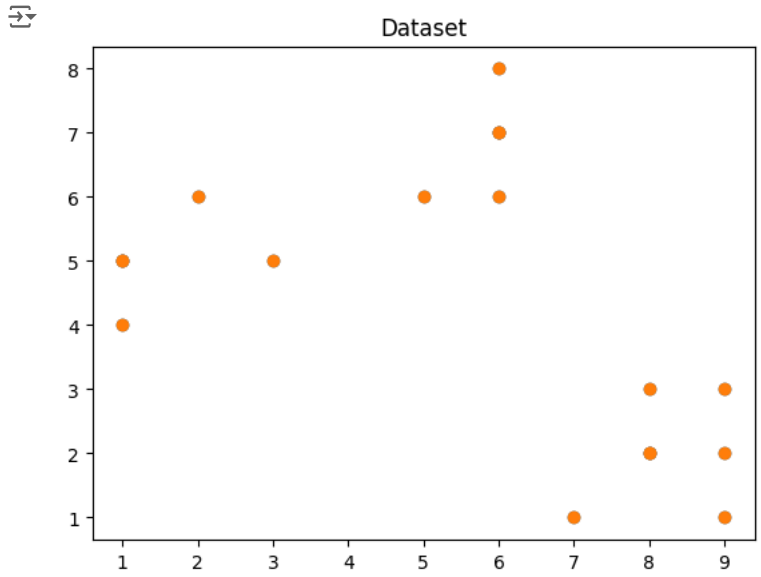
K-MEANS CLUSTERING

CODE

```
from sklearn.cluster import KMeans
from sklearn import metrics
from scipy.spatial.distance import cdist
import numpy as np
import matplotlib.pyplot as plt
x1 = np.array([3, 1, 1, 2, 1, 6, 6, 6, 5, 6, 7, 8, 9, 8, 9, 9, 8])
x2 = np.array([5, 4, 5, 6, 5, 8, 6, 7, 6, 7, 1, 2, 1, 2, 3, 2, 3])
X = np.array(list(zip(x1, x2))).reshape(len(x1), 2)
plt.scatter(X[:,0],X[:,1], label='True Position')
plt.title('Dataset')
plt.scatter(x1, x2)
plt.show()
```

OUTPUT

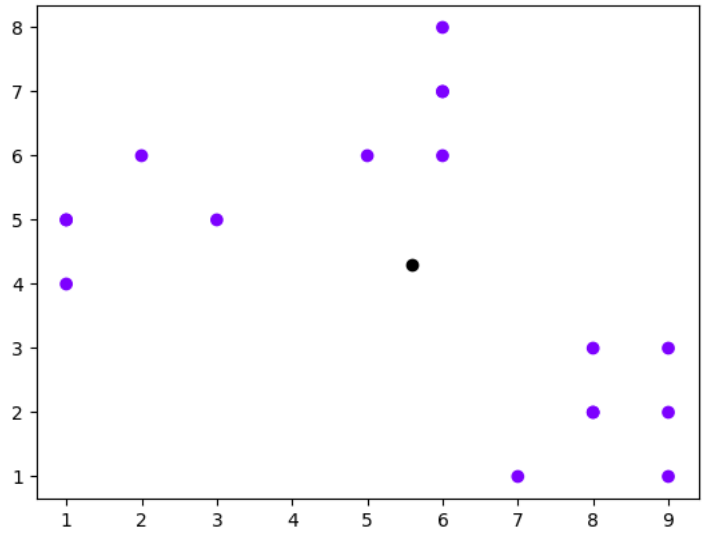


CODE

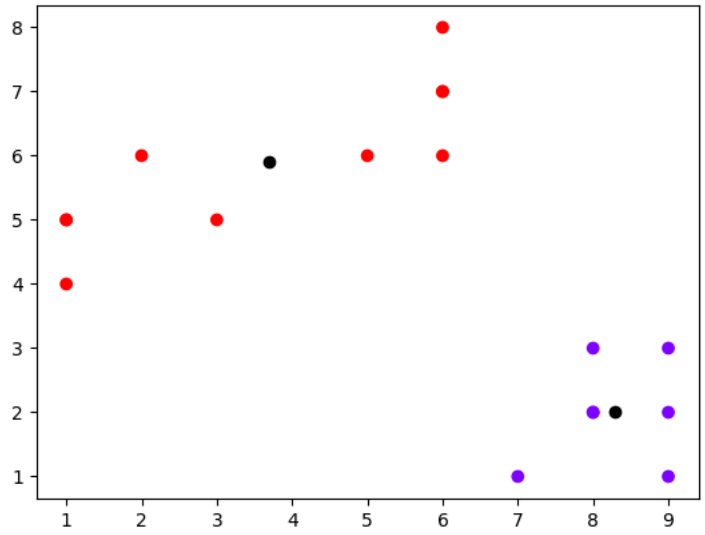
```
import matplotlib.pyplot as plt
distortions = []
mapping1 = {}
for k in range(1, 10):
  kmeanModel = KMeans(n_clusters=k)
  kmeanModel.fit(X)
  sse = sum(np.min(cdist(X, kmeanModel.cluster_centers_,'euclidean'), axis=1)) / X.shape[0]
  print("Value of K = ", k, ", SSE = ", sse)
  distortions.append(sum(np.min(cdist(X, kmeanModel.cluster_centers_,'euclidean'), axis=1)) / X.shape[0])
  mapping1[k] = sum(np.min(cdist(X, kmeanModel.cluster_centers_,'euclidean'), axis=1)) / X.shape[0]
  plt.scatter(X[:,0],X[:,1], c=kmeanModel.labels_, cmap='rainbow')
  plt.scatter(kmeanModel.cluster_centers_[:,0] ,kmeanModel.cluster_centers_[:,1], color='black')
  plt.show()
for key, val in mapping1.items():
    print(f'{key} : {val}')
plt.plot(range(1, 10), distortions, 'bx-')
plt.xlabel('Values of K')
plt.ylabel('Distortion')
plt.title('The Elbow Method using Distortion')
plt.show()
```

OUTPUT

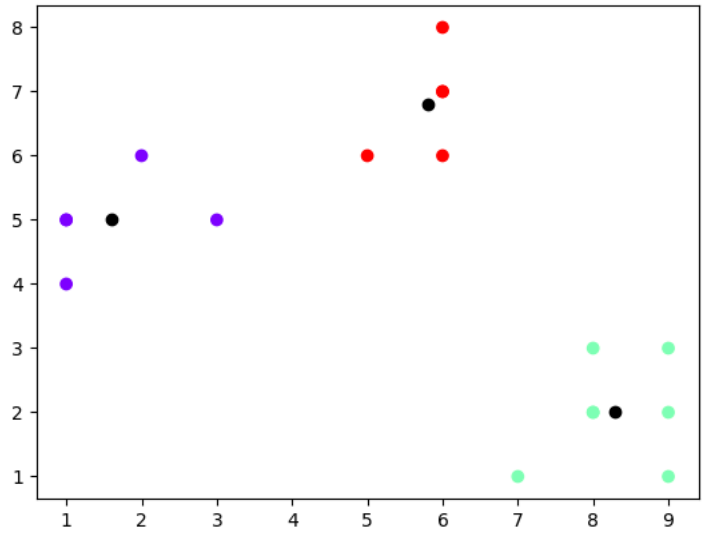
```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarni
  warnings.warn(
Value of K =  1 , SSE =  3.4577032384495707
```



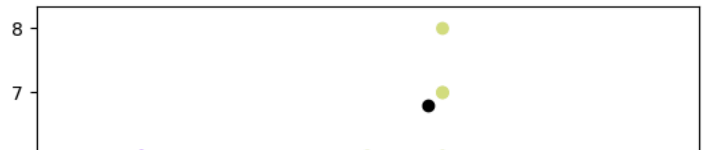
```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarni
  warnings.warn(
Value of K =  2 , SSE =  1.7687413573405673
```

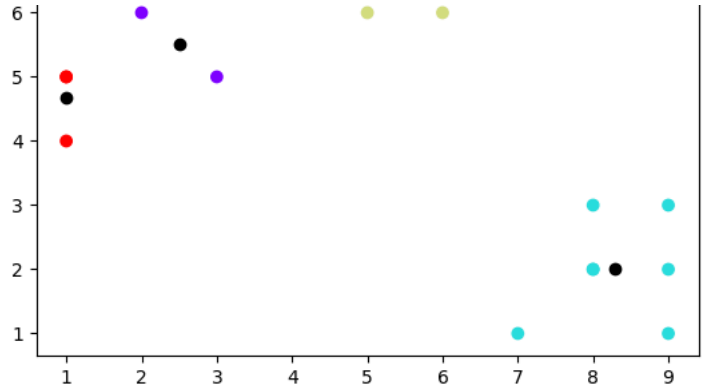


```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarni
  warnings.warn(
Value of K =  3 , SSE =  0.8819889697423957
```

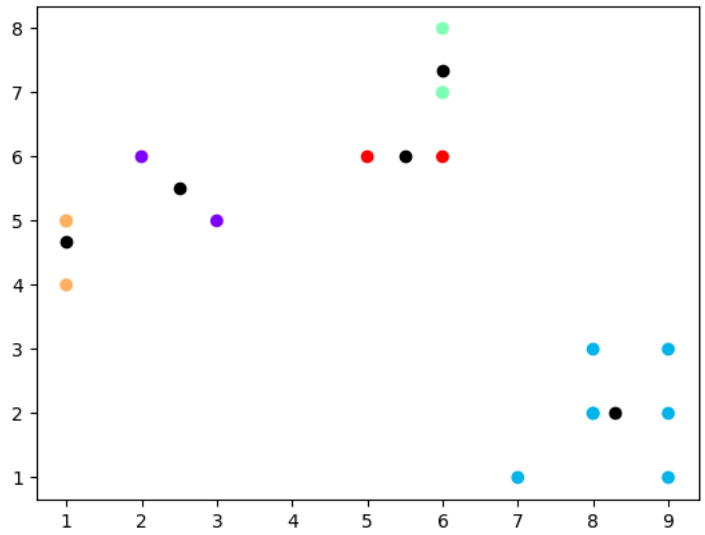


```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarni
  warnings.warn(
Value of K =  4 , SSE =  0.7587138847606585
```

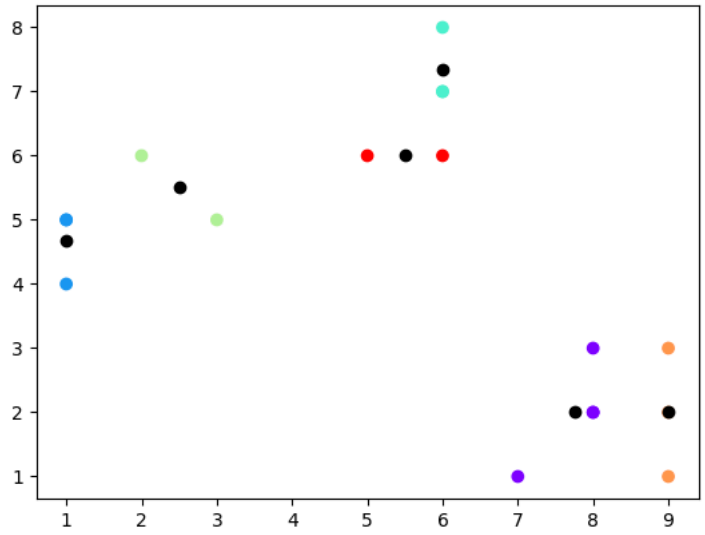




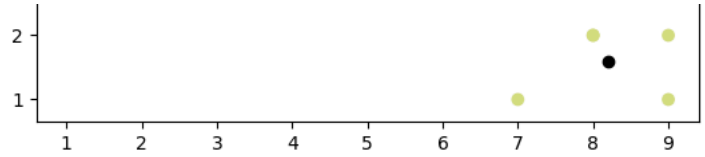

```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarni
  warnings.warn(
Value of K =  5 , SSE =  0.6760729098960964
```



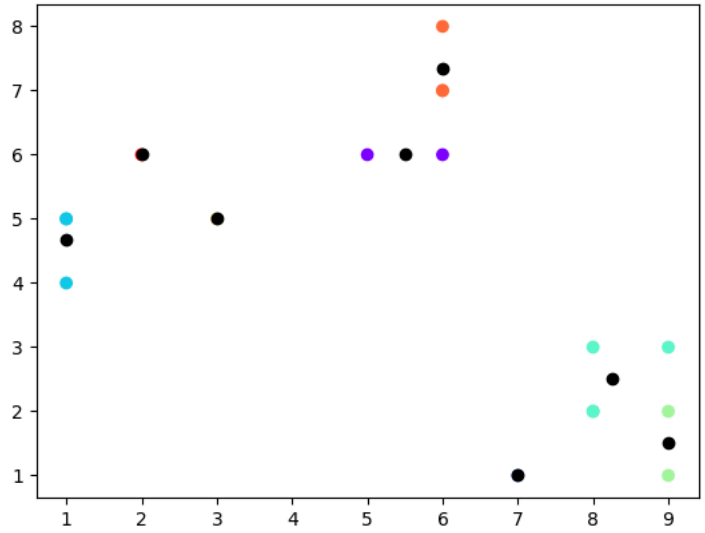

```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarni
  warnings.warn(
Value of K =  6 , SSE =  0.580097449143775
```



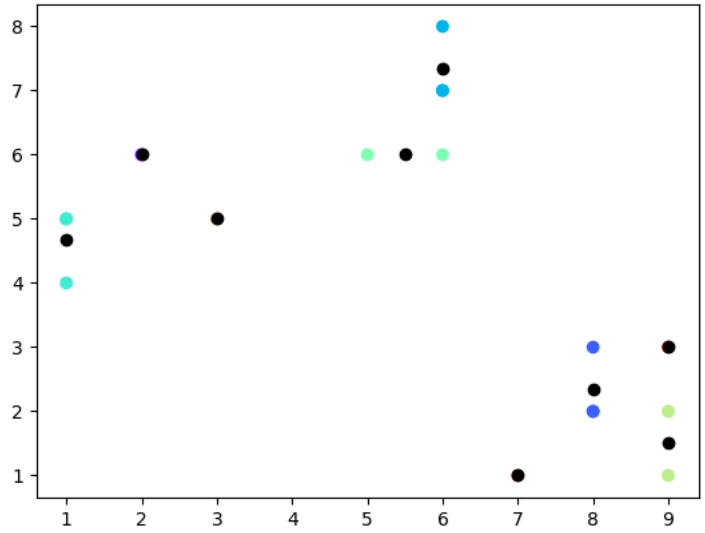

```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarni
  warnings.warn(
Value of K =  7 , SSE =  0.517480107950963
```



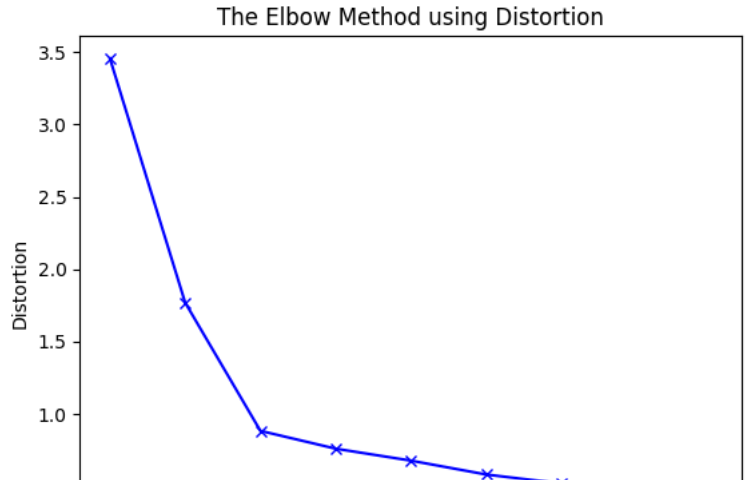

```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarni
  warnings.warn(
Value of K =  8 , SSE =  0.42618267462691206
```

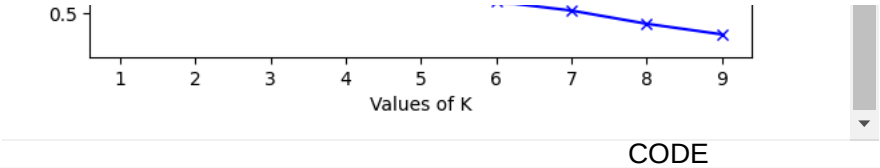



```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarni
  warnings.warn(
Value of K =  9 , SSE =  0.35294117647058826
```




```
1 : 3.4577032384495707
2 : 1.7687413573405673
3 : 0.8819889697423957
4 : 0.7587138847606585
5 : 0.6760729098960964
6 : 0.580097449143775
7 : 0.517480107950963
8 : 0.42618267462691206
9 : 0.35294117647058826
```

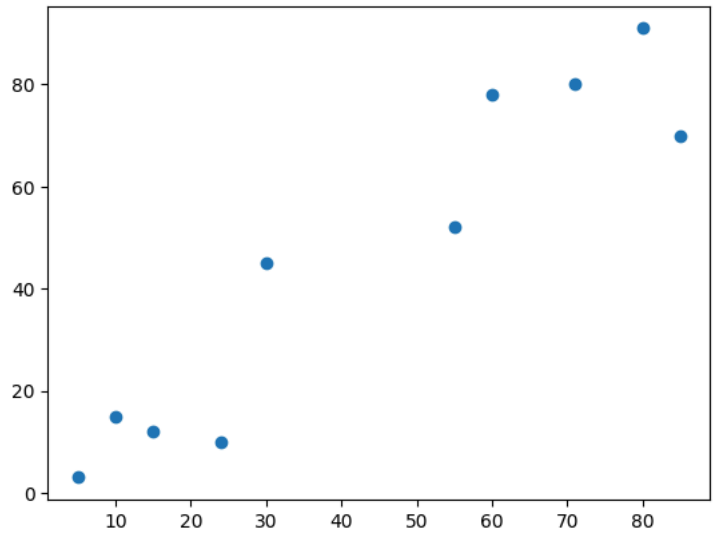




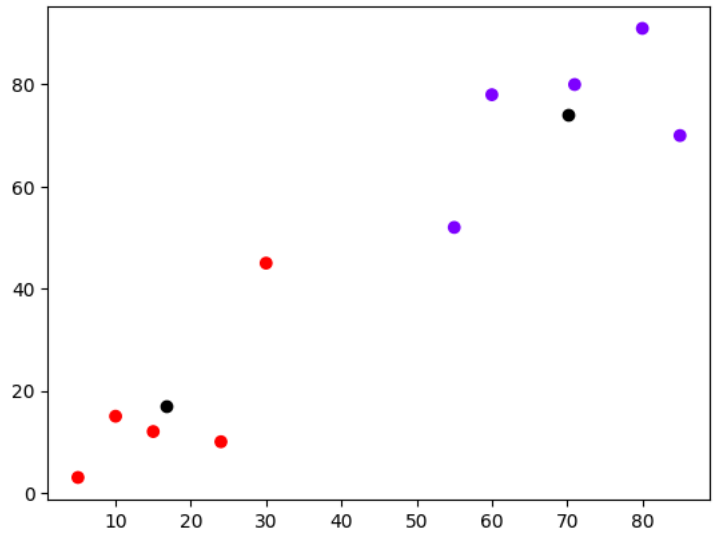
CODE

```
import matplotlib.pyplot as plt
import numpy as np
X = np.array([[5,3], [10,15], [15,12], [24,10], [30,45], [85,70], [71,80], [60,78], [55,52], [80,91],])
plt.scatter(X[:,0],X[:,1], label='True Position')
plt.show()
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score
kmeans = KMeans(n_clusters=2)
kmeans.fit(X)
print(kmeans.cluster_centers_)
print(kmeans.labels_)
cluster_labels = kmeans.predict(X)
C = kmeans.cluster_centers_
sil = silhouette_score(X, cluster_labels, metric='euclidean',sample_size = len(X))
print(C)
print("Quality of Clustering: ", sil)
plt.scatter(X[:,0],X[:,1], c=kmeans.labels_, cmap='rainbow')
plt.scatter(kmeans.cluster_centers_[:,0] ,kmeans.cluster_centers_[:,1], color='black')
plt.show()
```

OUTPUT




```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning:
  warnings.warn(
[[70.2 74.2]
 [16.8 17. ]]
[1 1 1 1 1 0 0 0 0 0]
[[70.2 74.2]
 [16.8 17. ]]
Quality of Clustering:  0.6586004781412067
```



CODE

```
import pandas as pd
import numpy as np
```

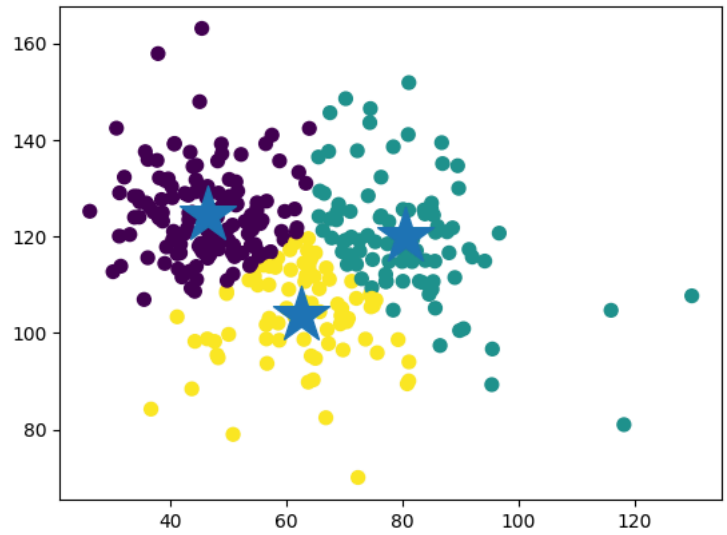
```
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score
data = pd.read_csv("/content/drive/MyDrive/JISNIT/Courses/ML/LectureNotes/data/spinem.csv")
X = data[['pelvic_incidence', 'pelvic_radius', 'thoracic_slope']]
kmeans = KMeans(n_clusters = 3, random_state = 123)
model = kmeans.fit(X)
cluster_labels = kmeans.predict(X)
X['Cluster'] = cluster_labels
print(X)
C = kmeans.cluster_centers_
sil = silhouette_score(X, cluster_labels, metric='euclidean',sample_size = len(data))
print(C)
print("Quality of Clustering: ", sil)
fig = plt.figure()
plt.scatter(X['pelvic_incidence'], X['pelvic_radius'], c=cluster_labels,
            s=50, cmap='viridis');
plt.scatter(C[:, 0], C[:, 1], marker='*', s=1000)
fig = plt.figure()
ax = Axes3D(fig)
ax.scatter(X['pelvic_incidence'], X['pelvic_radius'],
           X['thoracic_slope'],
           c=cluster_labels,
          cmap='viridis');
ax.scatter(C[:, 0], C[:, 1],  C[:, 2],
           marker='*',
           c='#050505')
```

OUTPUT

```
/usr/local/lib/python3.9/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning:
  warnings.warn(
     pelvic_incidence  pelvic_radius  thoracic_slope  Cluster
0           63.027817      98.672917         14.5386        2
1           39.056951     114.405425         17.5323        0
2           68.832021     105.985135         17.4861        2
3           69.297008     101.868495         12.7074        2
4           49.712859     108.168725         15.9546        2
..                ...            ...             ...      ...
305         47.903565     117.449062         14.7484        0
306         53.936748     114.365845         18.1972        0
307         61.446597     125.670725         13.5565        0
308         45.252792     118.545842         16.0928        0
309         33.841641     123.945244         17.6963        0

[310 rows x 4 columns]
[[ 46.42903837 124.47018491  13.26250567]
 [ 80.49567418 120.00557969  12.78133516]
 [ 62.59438009 103.64870812  13.03697051]]
Quality of Clustering:  0.3539586349354204
<ipython-input-1-cecf937cbdde>:12: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/us
  X['Cluster'] = cluster_labels
<mpl_toolkits.mplot3d.art3d.Path3DCollection at 0x7febd0c27790>
```




```
<Figure size 640x480 with 0 Axes>
```

The following code block implements k-means algorithm from the scratch

CODE

```
from sklearn.metrics import pairwise_distances_argmin
def find_clusters_kmeans(X, n_clusters, rseed=2):
    centers = [X[0], X[1], X[2]]
    print(centers)
    while True:
        labels = pairwise_distances_argmin(X, centers)
        new_centers = np.array([X[labels == i].mean(0)
                                for i in range(n_clusters)])
        if np.all(centers == new_centers):
            break
        centers = new_centers
    return centers, labels
X = np.array(X)
centers, cluster_labels = find_clusters_kmeans(X, 3)
plt.scatter(X[:, 0], X[:, 1], c=cluster_labels,
            s=50, cmap='viridis');
sil = silhouette_score(X, cluster_labels, metric='euclidean',sample_size = len(data))
print(centers)
print("Quality of Clustering: ", sil)
```

OUTPUT

```
[array([63.0278175 , 98.67291675, 14.5386    ,  2.        ]), array([ 39.05695098, 11
[[ 62.59438009 103.64870812  13.03697051   2.        ]
 [ 46.42903837 124.47018491  13.26250567   0.        ]
 [ 80.49567418 120.00557969  12.78133516   1.        ]]
Quality of Clustering:  0.3539586349354204
```