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UNIVERSITY PRACTICAL EXAMINATION

Subject Code: 18CSE398J

Subject Name: Machine Learning - Core Concepts with Applications ¶

Question Number 10:

Write a program to implement the k means clustering for a sample training data set from Kaggle. Compute the compute a silhouette score.

AIM:

TO IMPLEMENET THE K MEANS CLUSTERING FOR A SAMPLE TRAINING DATASET AND THEN COMPUTE IT'S SILHOUETTE SCORE

Importing all the necessary libraries

In [29]:

```
import numpy as np
import pandas as pd

from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_samples, silhouette_score

import matplotlib.pyplot as plt
import matplotlib.cm as cm
import seaborn as sns
```

Importing the DataSet and here we are using Mall Customer Segmentation dataset from Kaggle

In [21]:

```
input_data = pd.read_csv("https://raw.githubusercontent.com/PrakharNagpal/minuter-weather-k
```

In [22]:

```
input_data.head()
```

Out[22]:

	CustomerID	Gender	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 [23]:

```
input_data.shape
```

Out[23]:

```
(200, 5)
```

In [24]:

```
input_data.isnull().sum()
```

Out[24]:

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

In [25]:

```
# selecting features
x = input_data.iloc[:,[3,4]].values
```

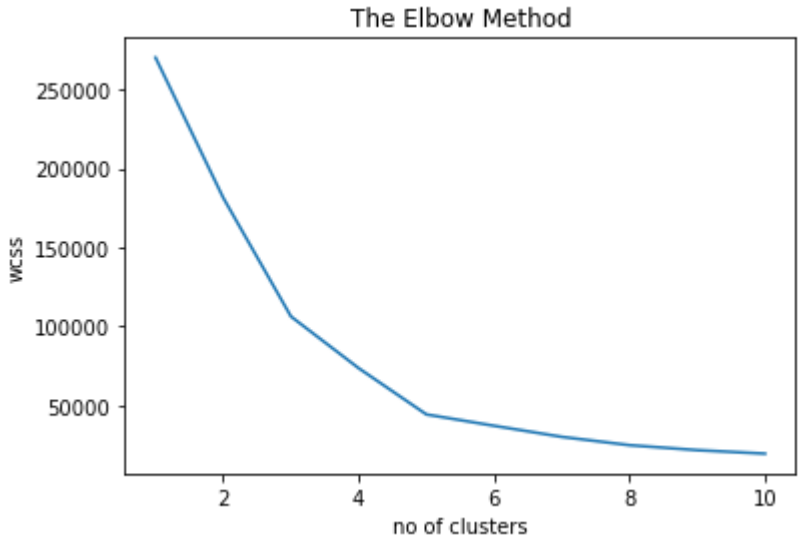
In [26]:

```
# Elbow Method

score = []

for cluster in range(1,11):
    kmeans = KMeans(n_clusters = cluster, init="k-means++", random_state=10)
    kmeans.fit(x)
    score.append(kmeans.inertia_)
```

```
C:\Users\Prakhar\anaconda3new\lib\site-packages\sklearn\cluster\_kmeans.py:8
81: 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 setti
ng the environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```

In [27]:

```
# plotting the score

plt.plot(range(1,11), score)
plt.title('The Elbow Method')
plt.xlabel('no of clusters')
plt.ylabel('wcss')
plt.show()
```



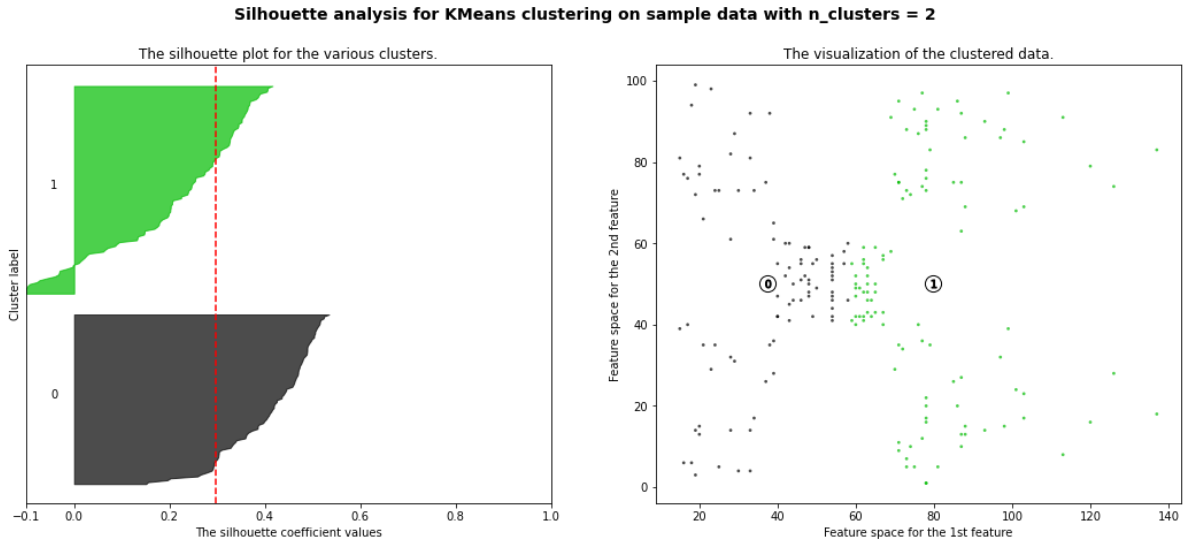
Hence the ideal number of clusters is 5

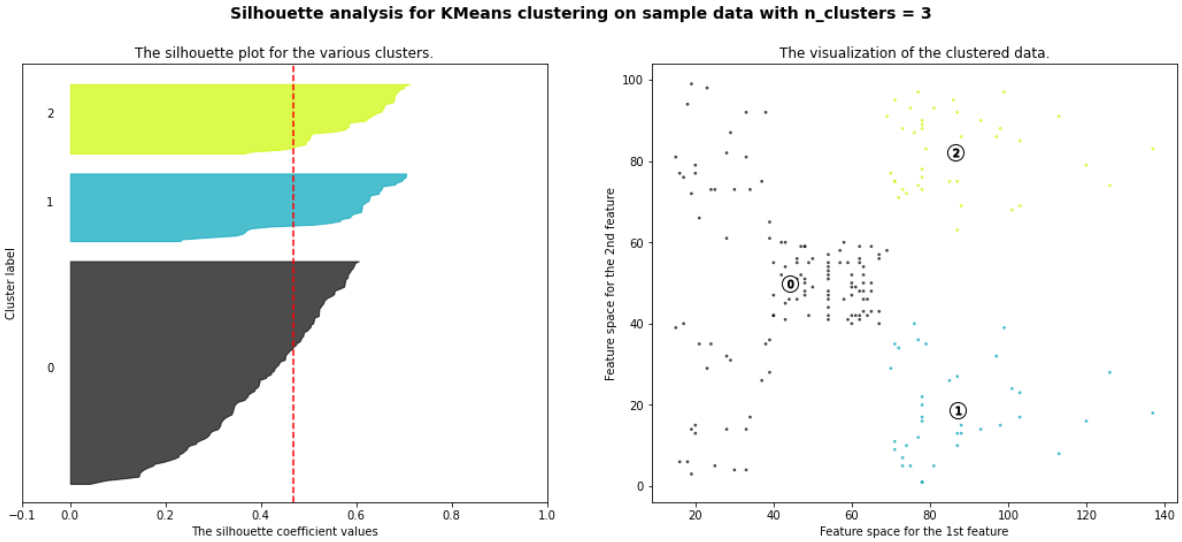
In [28]:

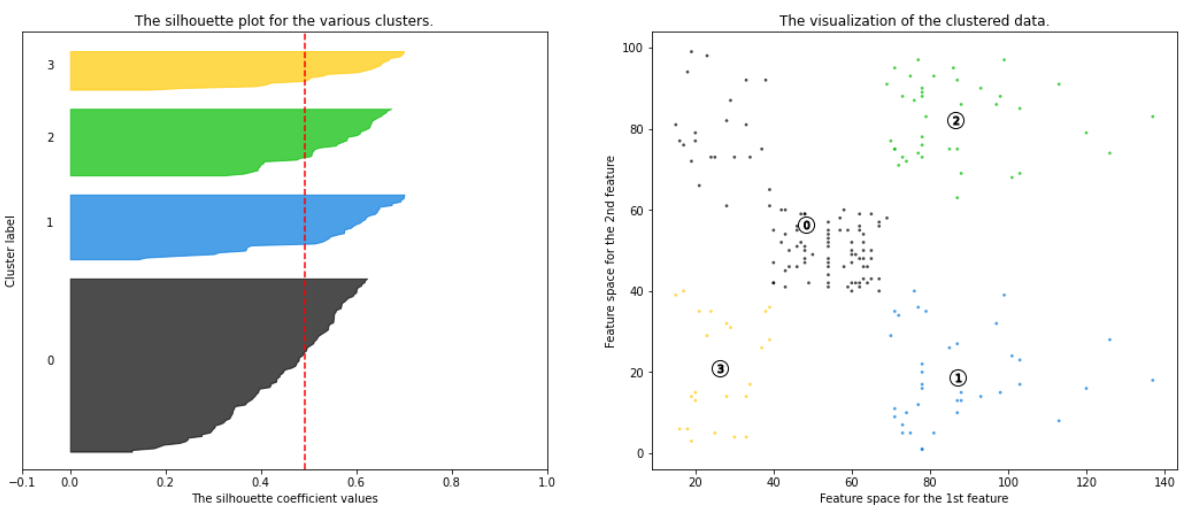
```
# Silhouette score

for n_clusters in range(2,11):
    # Create a subplot with 1 row and 2 columns
    fig, (ax1, ax2) = plt.subplots(1, 2)
    fig.set_size_inches(18, 7)

    # The 1st subplot is the silhouette plot
    # The silhouette coefficient can range from -1, 1 but in this example all
    # lie within [-0.1, 1]
    ax1.set_xlim([-0.1, 1])
    # The (n_clusters+1)*10 is for inserting blank space between silhouette
    # plots of individual clusters, to demarcate them clearly.
    ax1.set_ylim([0, len(x) + (n_clusters + 1) * 10])

    # Initialize the clusterer with n_clusters value and a random generator
    # seed of 10 for reproducibility.
    clusterer = KMeans(n_clusters=n_clusters, random_state=10)
    cluster_labels = clusterer.fit_predict(x)

    # The silhouette_score gives the average value for all the samples.
    # This gives a perspective into the density and separation of the formed
    # clusters
    silhouette_avg = silhouette_score(x, cluster_labels)
    print("For n_clusters =", n_clusters,
          "The average silhouette_score is :", silhouette_avg)

    # Compute the silhouette scores for each sample
    sample_silhouette_values = silhouette_samples(x, cluster_labels)

    y_lower = 10
    for i in range(n_clusters):
        # Aggregate the silhouette scores for samples belonging to
        # cluster i, and sort them
        ith_cluster_silhouette_values = \
            sample_silhouette_values[cluster_labels == i]

        ith_cluster_silhouette_values.sort()

        size_cluster_i = ith_cluster_silhouette_values.shape[0]
        y_upper = y_lower + size_cluster_i

        color = cm.nipy_spectral(float(i) / n_clusters)
        ax1.fill_betweenx(np.arange(y_lower, y_upper),
                          0, ith_cluster_silhouette_values,
                          facecolor=color, edgecolor=color, alpha=0.7)

        # Label the silhouette plots with their cluster numbers at the middle
        ax1.text(-0.05, y_lower + 0.5 * size_cluster_i, str(i))

        # Compute the new y_lower for next plot
        y_lower = y_upper + 10  # 10 for the 0 samples

    ax1.set_title("The silhouette plot for the various clusters.")
    ax1.set_xlabel("The silhouette coefficient values")
    ax1.set_ylabel("Cluster label")

    # The vertical line for average silhouette score of all the values
    ax1.axvline(x=silhouette_avg, color="red", linestyle="--")
```

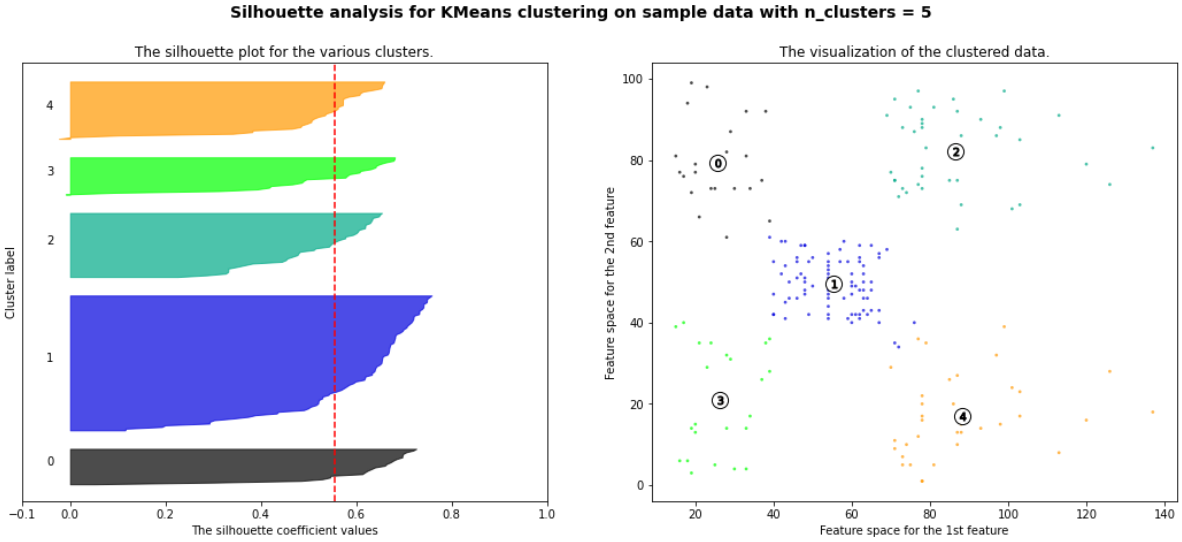
```
    ax1.set_yticks([])  # Clear the yaxis labels / ticks
    ax1.set_xticks([-0.1, 0, 0.2, 0.4, 0.6, 0.8, 1])

    # 2nd Plot showing the actual clusters formed
    colors = cm.nipy_spectral(cluster_labels.astype(float) / n_clusters)
    ax2.scatter(x[:, 0], x[:, 1], marker='.', s=30, lw=0, alpha=0.7,
                c=colors, edgecolor='k')

    # Labeling the clusters
    centers = clusterer.cluster_centers_
    # Draw white circles at cluster centers
    ax2.scatter(centers[:, 0], centers[:, 1], marker='o',
                c="white", alpha=1, s=200, edgecolor='k')

    for i, c in enumerate(centers):
        ax2.scatter(c[0], c[1], marker='$%d$' % i, alpha=1,
                    s=50, edgecolor='k')

    ax2.set_title("The visualization of the clustered data.")
    ax2.set_xlabel("Feature space for the 1st feature")
    ax2.set_ylabel("Feature space for the 2nd feature")

    plt.suptitle(("Silhouette analysis for KMeans clustering on sample data "
                  "with n_clusters = %d" % n_clusters),
                 fontsize=14, fontweight='bold')

plt.show()
```

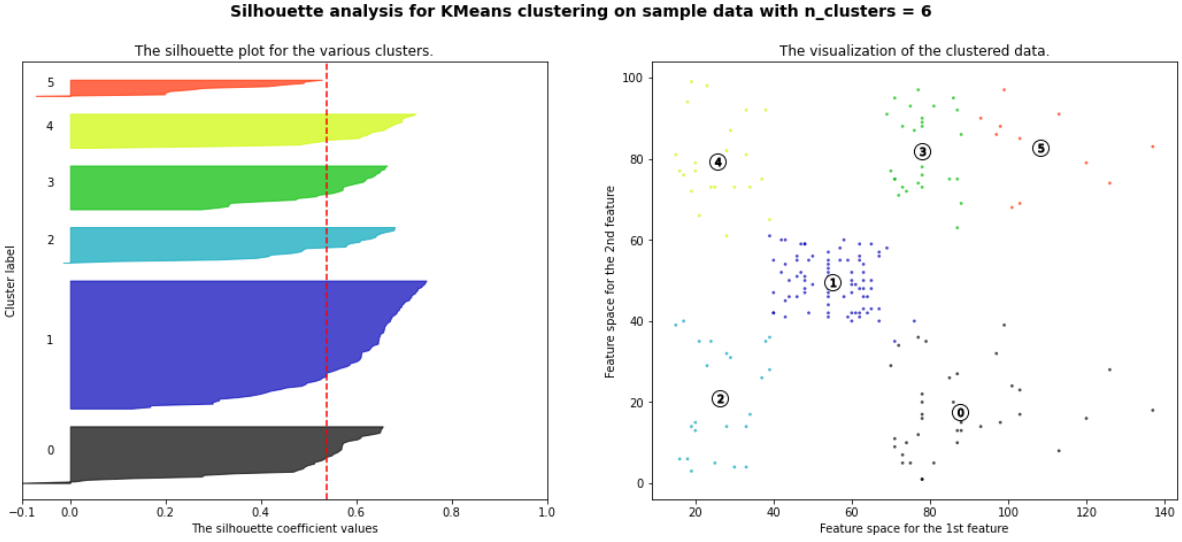
```
For n_clusters = 2 The average silhouette_score is : 0.2968969162503008
For n_clusters = 3 The average silhouette_score is : 0.46761358158775435
For n_clusters = 4 The average silhouette_score is : 0.4931963109249047
For n_clusters = 5 The average silhouette_score is : 0.553931997444648
For n_clusters = 6 The average silhouette_score is : 0.5376203956398481
For n_clusters = 7 The average silhouette_score is : 0.5270287298101395
For n_clusters = 8 The average silhouette_score is : 0.4572211842776841
For n_clusters = 9 The average silhouette_score is : 0.45872989167156364
For n_clusters = 10 The average silhouette_score is : 0.4467356774401869
```

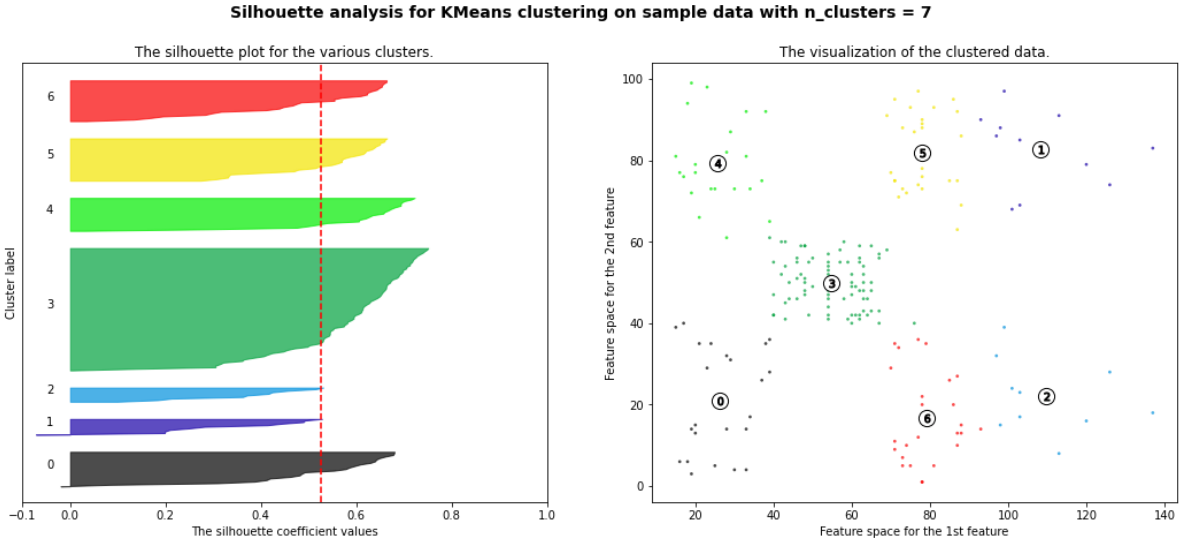


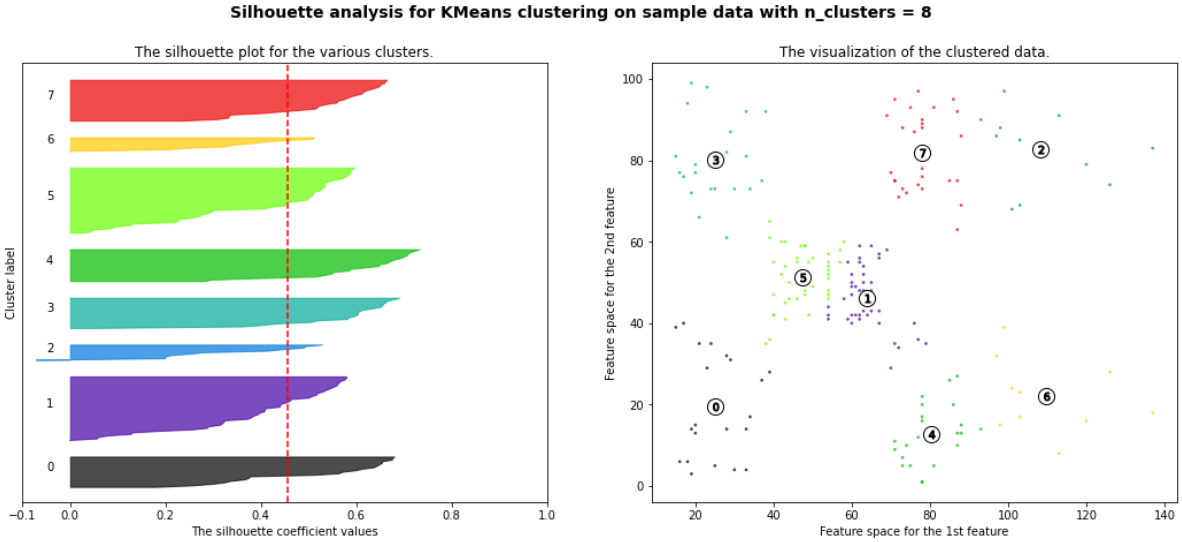

Silhouette analysis for KMeans clustering on sample data with n_clusters = 3
The silhouette plot for the various clusters.
Cluster label
The silhouette coefficient values
The visualization of the clustered data.
Feature space for the 2nd feature
Feature space for the 1st feature

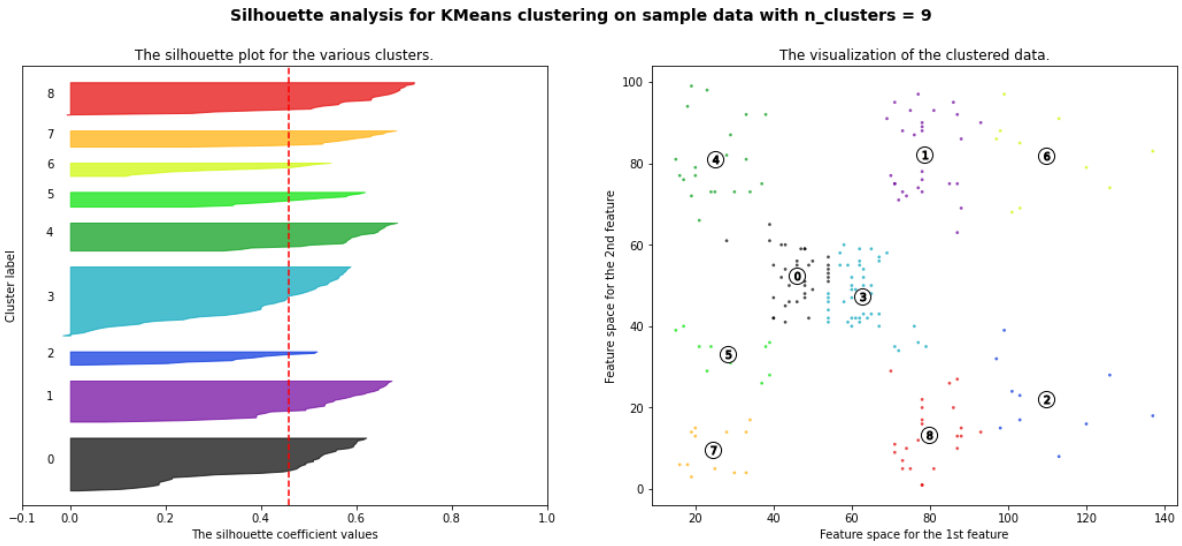

Silhouette analysis for KMeans clustering on sample data with n_clusters = 4
The silhouette plot for the various clusters.
Cluster label
The silhouette coefficient values
The visualization of the clustered data.
Feature space for the 2nd feature
Feature space for the 1st feature

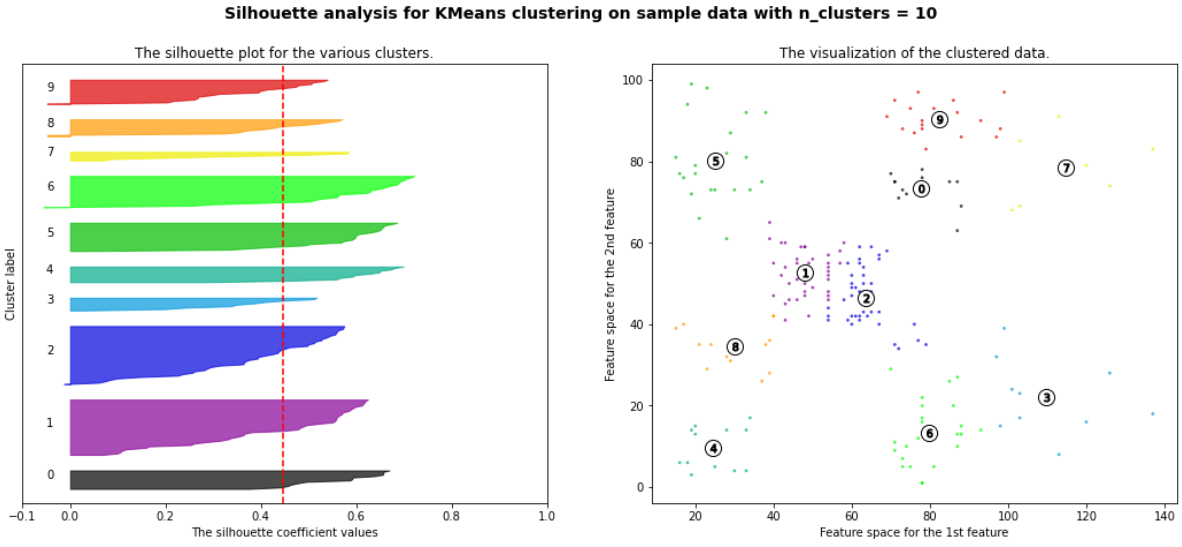

Silhouette analysis for KMeans clustering on sample data with n_clusters = 5
The silhouette plot for the various clusters.
Cluster label
The silhouette coefficient values
The visualization of the clustered data.
Feature space for the 2nd feature
Feature space for the 1st feature


Silhouette analysis for KMeans clustering on sample data with n_clusters = 6
The silhouette plot for the various clusters.
Cluster label
The silhouette coefficient values
The visualization of the clustered data.
Feature space for the 2nd feature
Feature space for the 1st feature


Silhouette analysis for KMeans clustering on sample data with n_clusters = 7
The silhouette plot for the various clusters.
Cluster label
The silhouette coefficient values
The visualization of the clustered data.
Feature space for the 2nd feature
Feature space for the 1st feature


Silhouette analysis for KMeans clustering on sample data with n_clusters = 8
The silhouette plot for the various clusters.
Cluster label
The silhouette coefficient values
The visualization of the clustered data.
Feature space for the 2nd feature
Feature space for the 1st feature


Silhouette analysis for KMeans clustering on sample data with n_clusters = 9
The silhouette plot for the various clusters.
Cluster label
The silhouette coefficient values
The visualization of the clustered data.
Feature space for the 2nd feature
Feature space for the 1st feature


Silhouette analysis for KMeans clustering on sample data with n_clusters = 10
The silhouette plot for the various clusters.
Cluster label
The silhouette coefficient values
The visualization of the clustered data.
Feature space for the 2nd feature
Feature space for the 1st feature

Inference:

Hence here we have determined silhouette scores for n_clusters rangigf from 2 to 10 and the score were :

For n_clusters = 2 The average silhouette_score is : 0.2968969162503008

For n_clusters = 3 The average silhouette_score is : 0.46761358158775435

For n_clusters = 4 The average silhouette_score is : 0.4931963109249047

For n_clusters = 5 The average silhouette_score is : 0.553931997444648

For n_clusters = 6 The average silhouette_score is : 0.5376203956398481

For n_clusters = 7 The average silhouette_score is : 0.5270287298101395

For n_clusters = 8 The average silhouette_score is : 0.4572211842776841

For n_clusters = 9 The average silhouette_score is : 0.45872989167156364

For n_clusters = 10 The average silhouette_score is : 0.4467356774401869

Result:

Hence the model was successfult build for Mall Segmentation Dataset and silhoutte scores were observed for various n_clusters ranging from 2 to 10