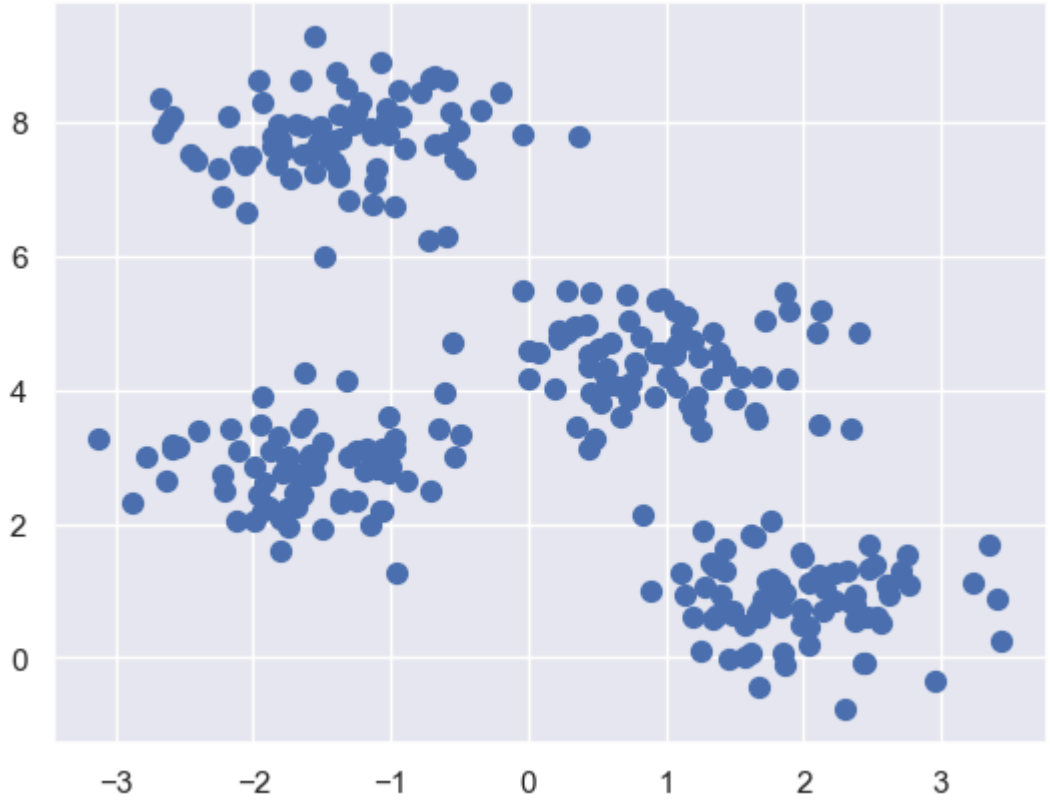
EXPERIMENT 9 Aim: Implementation of K-Mean Clustering Objectives: To Study K-Mean Clustering To implement K-Mean clustering algorithm and to predict the target variable. Course Outcomes: CO2, CO4

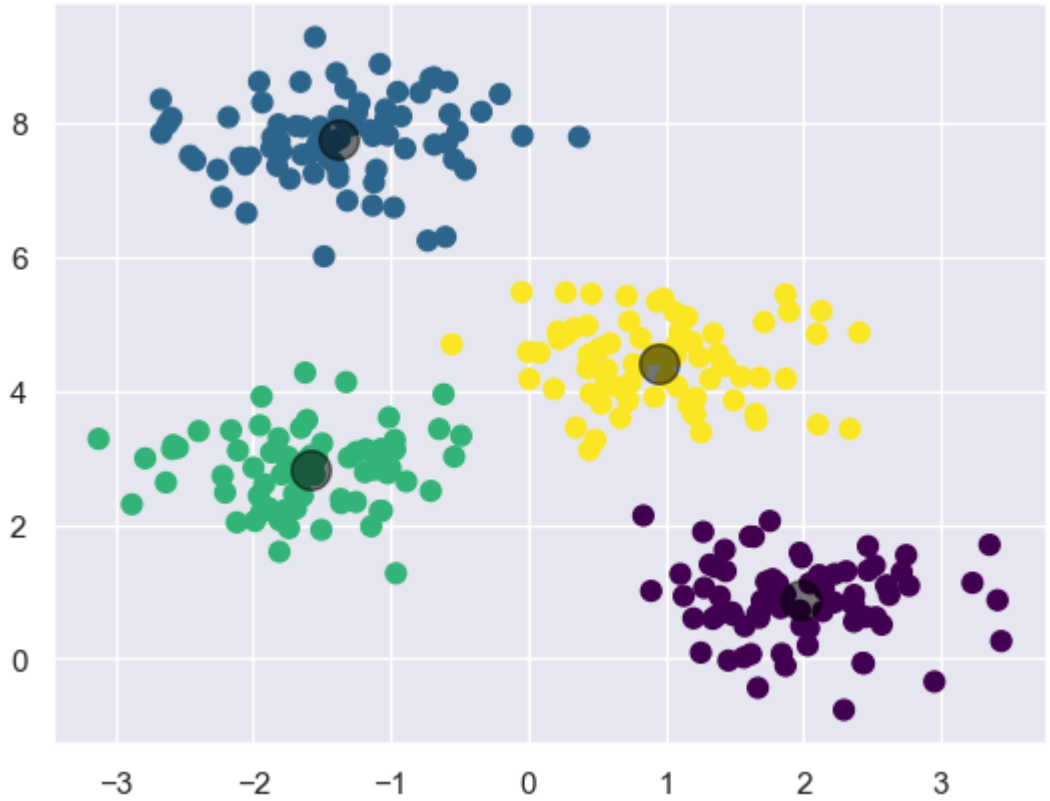
In [5]:
```
import matplotlib.pyplot as plt
import seaborn as sns; sns.set() # for plot styling
import numpy as np
from sklearn.datasets import make_blobs
from sklearn.cluster import KMeans
import pandas as pd
import plotly as py
import plotly.graph_objs as go
```

In [2]:
```
X, y_true = make_blobs(n_samples=300, centers=4, cluster_std=0.60, random_state=0)
plt.scatter(X[:, 0], X[:, 1], s=50);
```



In [3]:
```
#4 Clusters
kmeans = KMeans(n_clusters=4)
kmeans.fit(X)
y_kmeans = kmeans.predict(X)
plt.scatter(X[:, 0], X[:, 1], c=y_kmeans, s=50, cmap='viridis')
centers = kmeans.cluster_centers_
plt.scatter(centers[:, 0], centers[:, 1], c='black', s=200, alpha=0.5);
```

```
C:\Users\admin\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will cha
nge from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\admin\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak o
n Windows with MKL, when there are less chunks than available threads. You can avoid it by setting the environment variable OMP_
NUM_THREADS=2.
  warnings.warn(
```



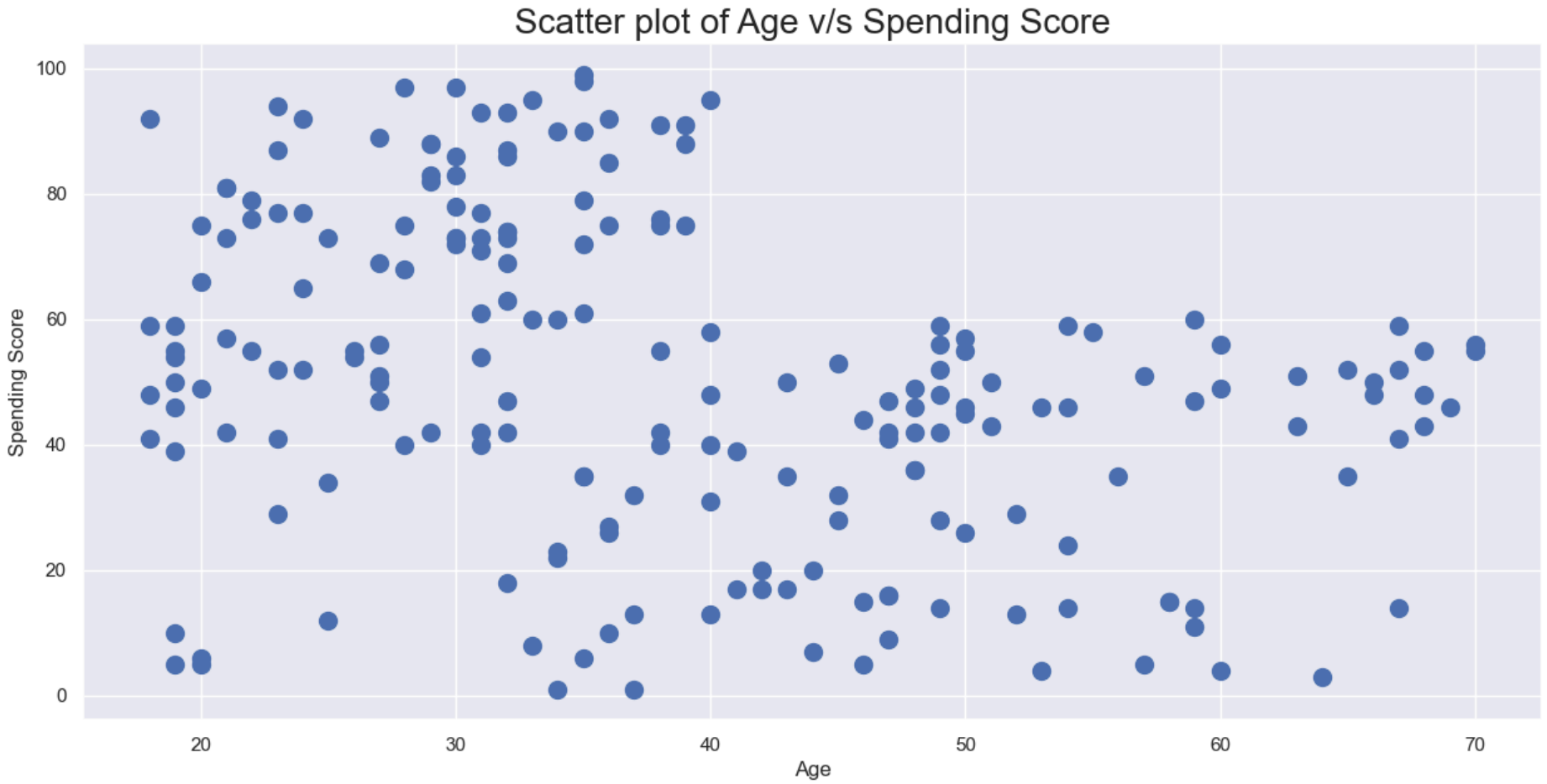
In [6]:
```
df = pd.read_csv('Exp-9.csv')
df.head()
```

Out[6]:

	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

2D Clustering based on Age and Spending Score

In [7]:
```
plt.figure(1 , figsize = (15 , 7))
plt.title('Scatter plot of Age v/s Spending Score', fontsize = 20)
plt.xlabel('Age')
plt.ylabel('Spending Score')
plt.scatter( x = 'Age', y = 'Spending Score (1-100)', data = df, s = 100)
plt.show()
```

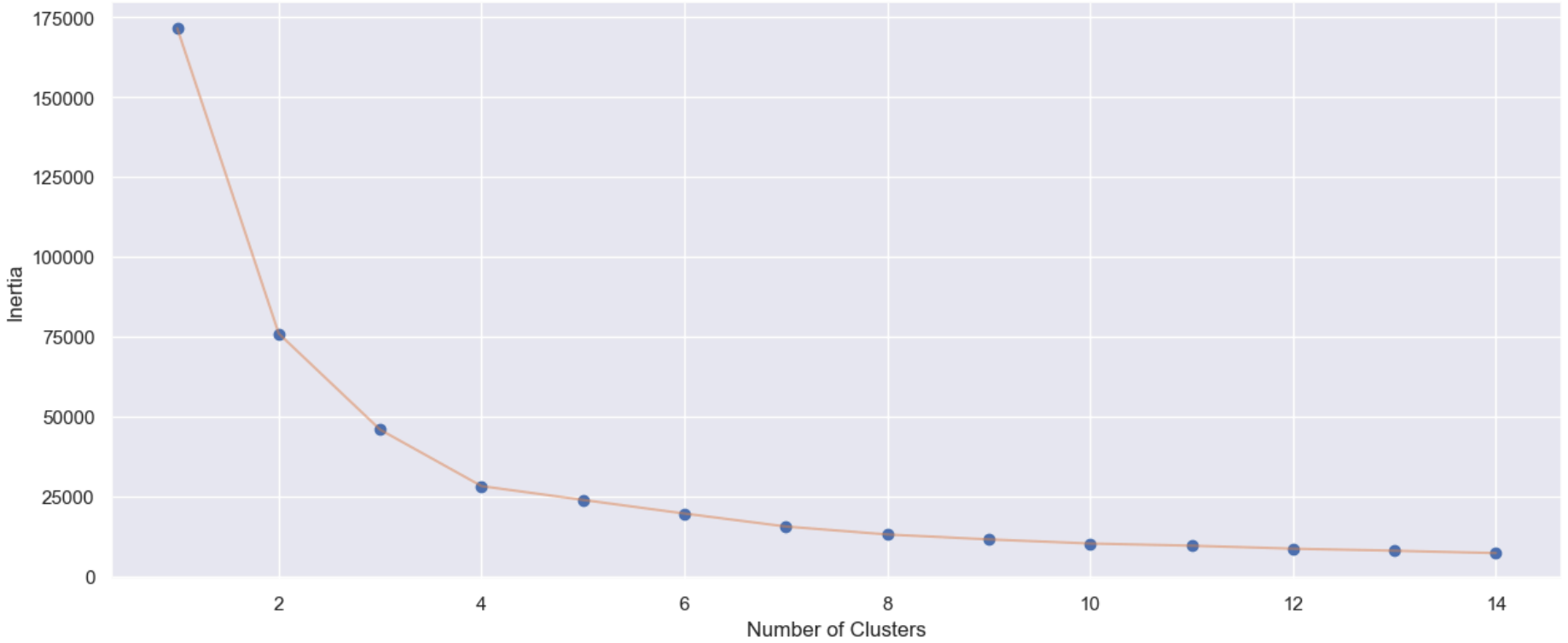


Deciding K value

In [8]:
```
X1 = df[['Age' , 'Spending Score (1-100)']].iloc[: , :].values
inertia = []
for n in range(1 , 15):
    algorithm = (KMeans(n_clusters = n ,init='k-means++', n_init = 10 ,max_iter=300,
                        tol=0.0001,  random_state= 111  , algorithm='elkan') )
    algorithm.fit(X1)
    inertia.append(algorithm.inertia_)
```

```
C:\Users\admin\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1373: RuntimeWarning: algorithm='elkan' doesn't make sense for a single cluster. Using 'lloyd' instead.
  warnings.warn(
C:\Users\admin\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(
```

In [9]:
```
plt.figure(1 , figsize = (15 ,6))
plt.plot(np.arange(1 , 15) , inertia , 'o')
plt.plot(np.arange(1 , 15) , inertia , '-' , alpha = 0.5)
plt.xlabel('Number of Clusters') , plt.ylabel('Inertia')
plt.show()
```



Applying KMeans for k=4

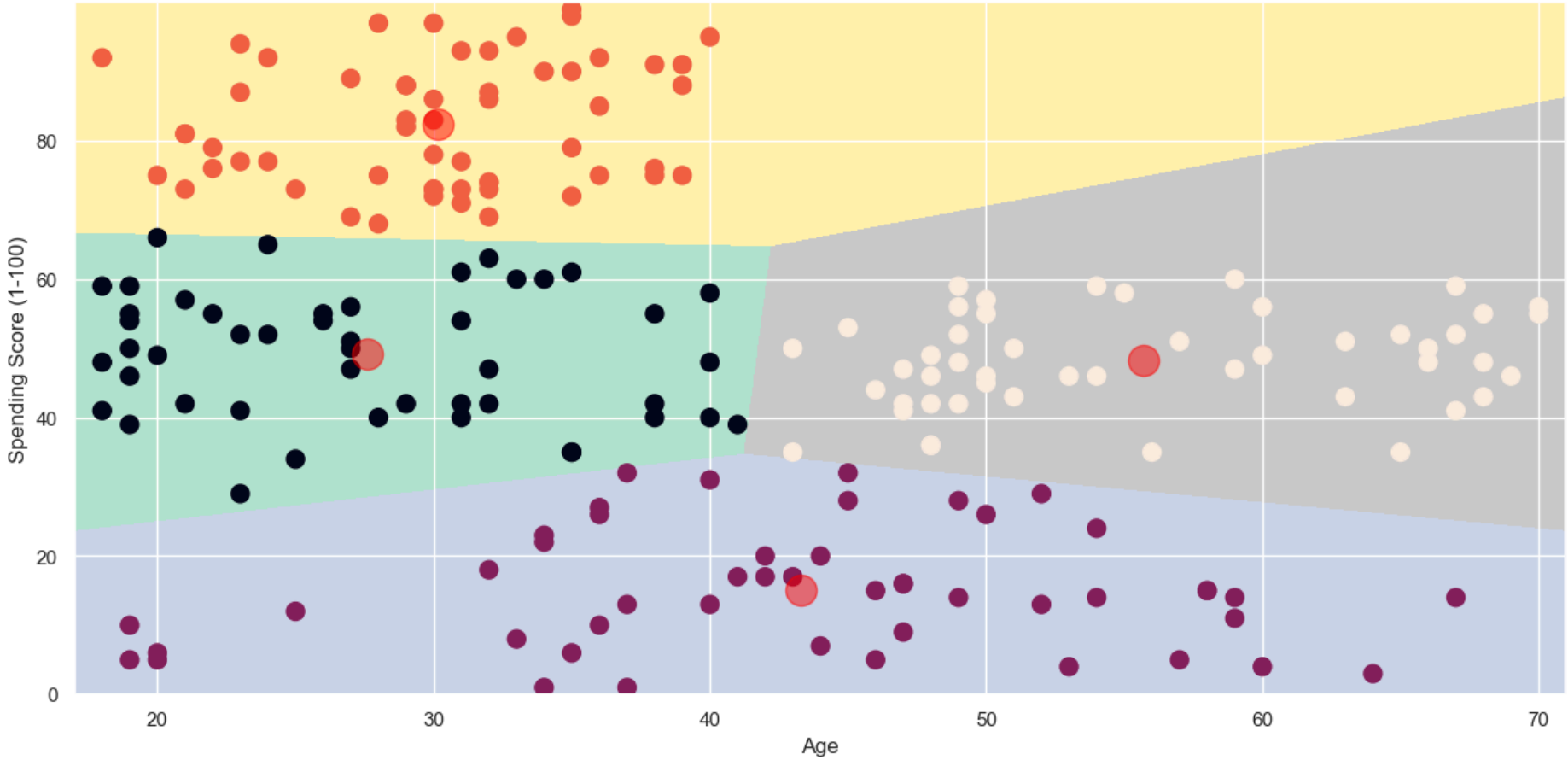
In [10]:
```
algorithm = (KMeans(n_clusters = 4 ,init='k-means++', n_init = 10 ,max_iter=300,
                    tol=0.0001,  random_state= 111  , algorithm='elkan') )
```

```
algorithm.fit(X1)
labels1 = algorithm.labels_
centroids1 = algorithm.cluster_centers_
```

In [11]:
```
h = 0.02
x_min, x_max = X1[:, 0].min() - 1, X1[:, 0].max() + 1
y_min, y_max = X1[:, 1].min() - 1, X1[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))
Z = algorithm.predict(np.c_[xx.ravel(), yy.ravel()])
```

In [12]:
```
plt.figure(1 , figsize = (15 , 7) )
plt.clf()
Z = Z.reshape(xx.shape)
plt.imshow(Z , interpolation='nearest',
           extent=(xx.min(), xx.max(), yy.min(), yy.max()),
           cmap = plt.cm.Pastel2, aspect = 'auto', origin='lower')

plt.scatter( x = 'Age', y = 'Spending Score (1-100)', data = df, c = labels1, s = 100)
plt.scatter(x = centroids1[: , 0] , y =  centroids1[: , 1] , s = 300 , c = 'red' , alpha = 0.5)
plt.ylabel('Spending Score (1-100)') , plt.xlabel('Age')
plt.show()
```



The silhouette coefficient is a measure of cluster cohesion and separation. It quantifies how well a data point fits into its assigned cluster based on two factors:

In [14]:
```
kmeans_kwargs = {
"init": "random",
"n_init": 10,
"max_iter": 300,
"random_state": 42,
  }
```

In [19]:
```
scaled_features=X1
from sklearn.metrics import silhouette_score
```

In [20]:
```
silhouette_coefficients = []
# Notice you start at 2 clusters for silhouette coefficient
for k in range(2, 11):
    kmeans = KMeans(n_clusters=k, **kmeans_kwargs)
    kmeans.fit(scaled_features)
    score = silhouette_score(scaled_features, kmeans.labels_)
    silhouette_coefficients.append(score)
```

```
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NUM_THREADS=1.
  warnings.warn(
```
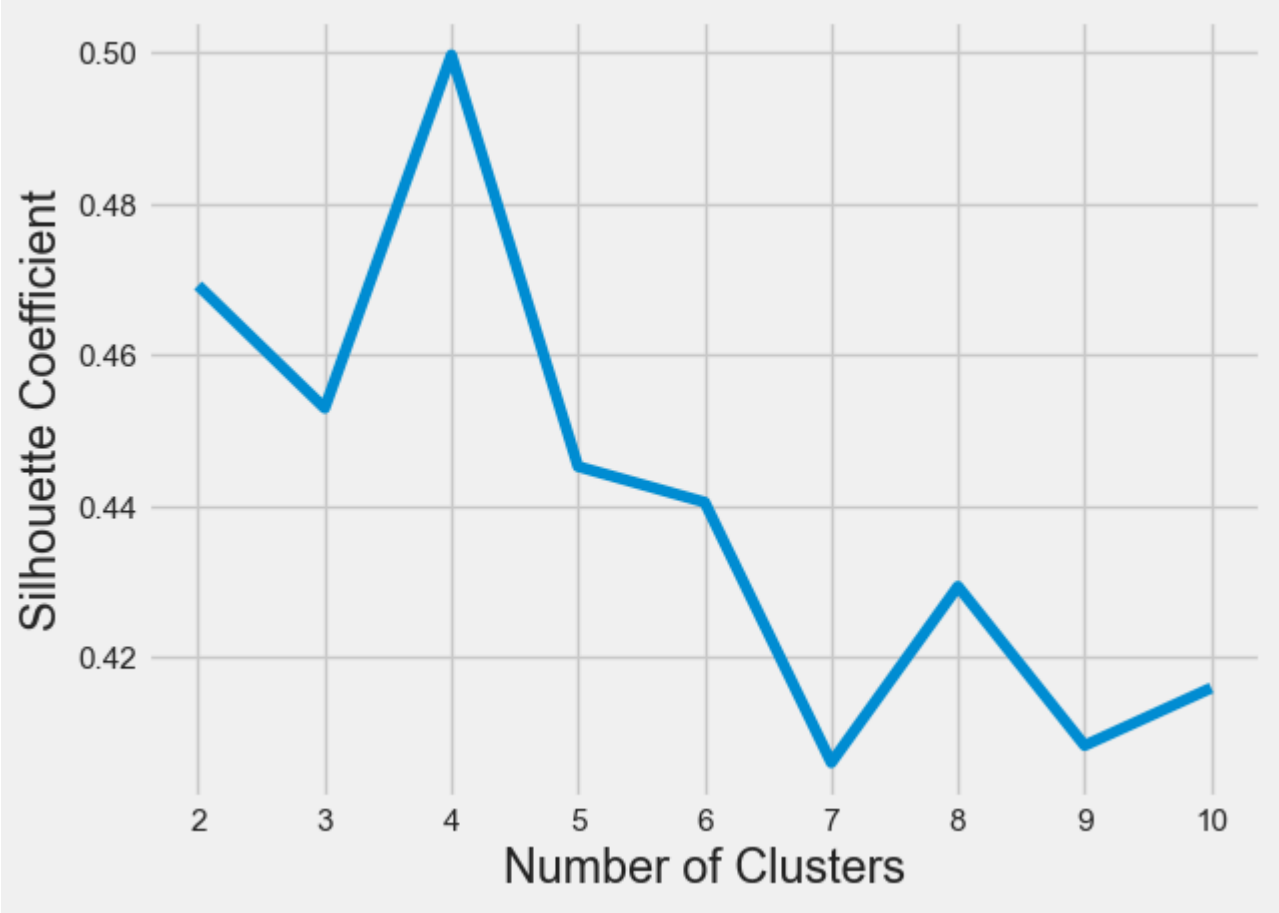

In [21]:

```
plt.style.use("fivethirtyeight")
plt.plot(range(2, 11), silhouette_coefficients)
plt.xticks(range(2, 11))
plt.xlabel("Number of Clusters")
plt.ylabel("Silhouette Coefficient")
plt.show()
```



Plotting the average silhouette scores for each k shows that the best choice for k is 4 since it has the maximum score:

Learning Outcomes: I Got to know about kmeans clustering algorithm and how to form the clusters and how to find the number of clusters. I learned how to find silhouette scores for evaluating clusters.

Result/discussin: I have successfully implemented kmeans clustering algorithm.

In [ ]: