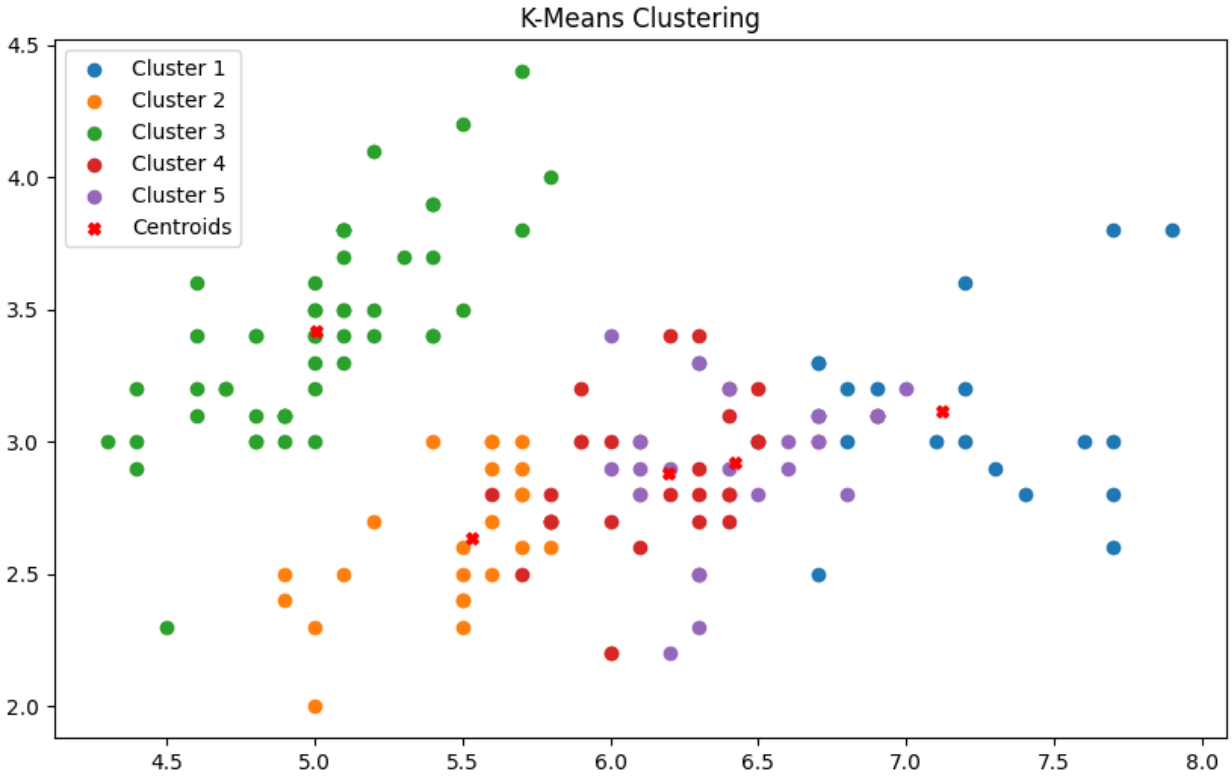
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
df = pd.read_csv('Iris.csv')
df1 = pd.read_csv('Iris_Labeled.csv')

X = df.values
X = df1.iloc[:, :-1].values
labels = df1.iloc[:, -1].values
def euclidean_distance(a, b):
    return np.sqrt(np.sum((a - b) ** 2))
def kmeans_a(X, k, max_iters=1000):
    n_samples, n_features = X.shape
    centroids = X[np.random.choice(n_samples, k, replace=False)]
    for _ in range(max_iters):
        clusters = [[] for _ in range(k)]
        for idx, sample in enumerate(X):
            distances = [euclidean_distance(sample, point) for point
in centroids]
            cluster_idx = np.argmin(distances)
            clusters[cluster_idx].append(idx)
        new_centroids = np.array([np.mean(X[cluster], axis=0) for
cluster in clusters])
        if np.all(centroids == new_centroids):
            break
        centroids = new_centroids
    return centroids, clusters, _
def kmeans_b(X, initial_centroids, max_iters=1000):
    k = len(initial_centroids)
    centroids = np.array(initial_centroids)
    for iteration in range(max_iters):
        clusters = [[] for _ in range(k)]
        for idx, sample in enumerate(X):
            distances = [euclidean_distance(sample, point) for point
in centroids]
            cluster_idx = np.argmin(distances)
            clusters[cluster_idx].append(idx)
        new_centroids = np.array([np.mean(X[cluster], axis=0) for
cluster in clusters])
        if np.all(centroids == new_centroids):
            break
        centroids = new_centroids
    return centroids, clusters, iteration + 1
def calculate_sse(X, centroids, clusters):
    sse = 0
    for i, cluster in enumerate(clusters):
        for idx in cluster:
            sse += euclidean_distance(X[idx], centroids[i]) ** 2
    return sse
def silhouette_score(X, clusters):
```

```
    n_samples = len(X)
    s = 0
    for i, cluster in enumerate(clusters):
        for idx in cluster:
            a = np.mean([euclidean_distance(X[idx], X[idx2]) for idx2
in cluster if idx != idx2])
            b = np.min([np.mean([euclidean_distance(X[idx], X[idx2])
for idx2 in other_cluster]) for other_cluster in clusters if
other_cluster != cluster])
        s += (b - a) / max(a, b)
    return s / n_samples
def get_initial_centroids(X, labels, k):
    unique_labels = np.unique(labels)
    initial_centroids = []
    for label in unique_labels:
        if k == 0:
            break
        initial_centroids.append(X[labels == label][0])
        k -= 1
    return initial_centroids

best_sse = float('inf')
best_k = 0
results1 = []

for k in range(2, 6):
    centroids, clusters, iter = kmeans_a(X, k)
    sse = calculate_sse(X, centroids, clusters)
    s = silhouette_score(X, clusters)
    if sse < best_sse:
        best_sse = sse
        best_k = k
    results1.append((k, sse, s, iter))

print("K\tSSE\t\tSilhouette Coefficient\tIterations")
for k, sse, silhouette, n_iters in results1:
    print(f"{k}\t{sse:.2f}\t\t{silhouette:.5f}\t\t\t{n_iters}")
centroids, clusters, iter = kmeans_a(X, best_k)
plt.figure(figsize=(10, 6))

for i in range(best_k):
    cluster_points = X[clusters[i]]
    plt.scatter(cluster_points[:, 0], cluster_points[:, 1],
label=f'Cluster {i+1}')
plt.scatter(centroids[:, 0], centroids[:, 1], s=30, c='red',
marker='X', label='Centroids')
plt.title('K-Means Clustering')
plt.legend()
plt.show()
```

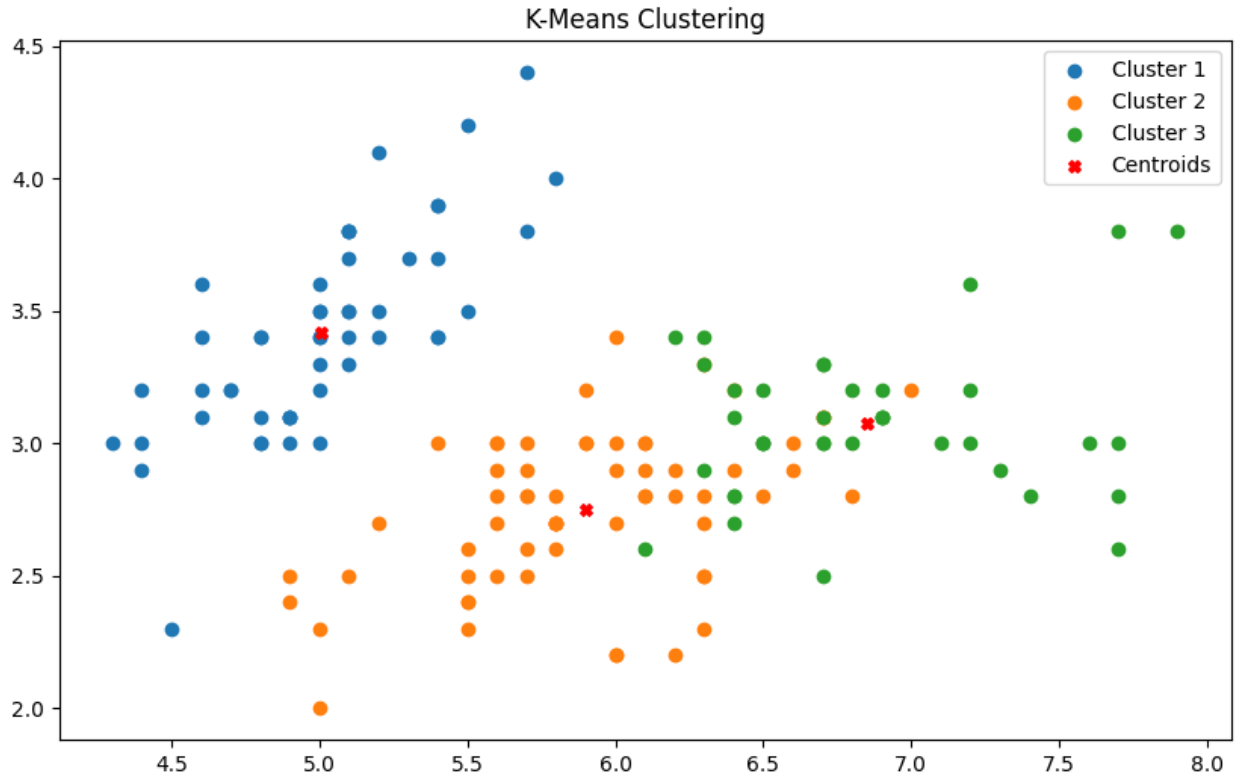
```
K     SSE         Silhouette Coefficient      Iterations
2     152.37           0.00612                1
3     143.45           0.00970                6
4     57.47       0.01279                8
5     49.88       0.01211                9
```




```python
k_values = [2, 3]
results = []

for k in k_values:
    initial_centroids = get_initial_centroids(X, labels, k)
    centroids, clusters, n_iters = kmeans_b(X, initial_centroids)
    sse = calculate_sse(X, centroids, clusters)
    silhouette = silhouette_score(X, clusters)
    results.append((k, sse, silhouette, n_iters))

print("K\tSSE\t\tSilhouette Coefficient\tIterations")
for k, sse, silhouette, n_iters in results:
    print(f"{k}\t{sse:.2f}\t\t{silhouette:.5f}\t\t\t{n_iters}")

best_k = 3
initial_centroids = get_initial_centroids(X, labels, best_k)
centroids, clusters, _ = kmeans_b(X, initial_centroids)

plt.figure(figsize=(10, 6))
```

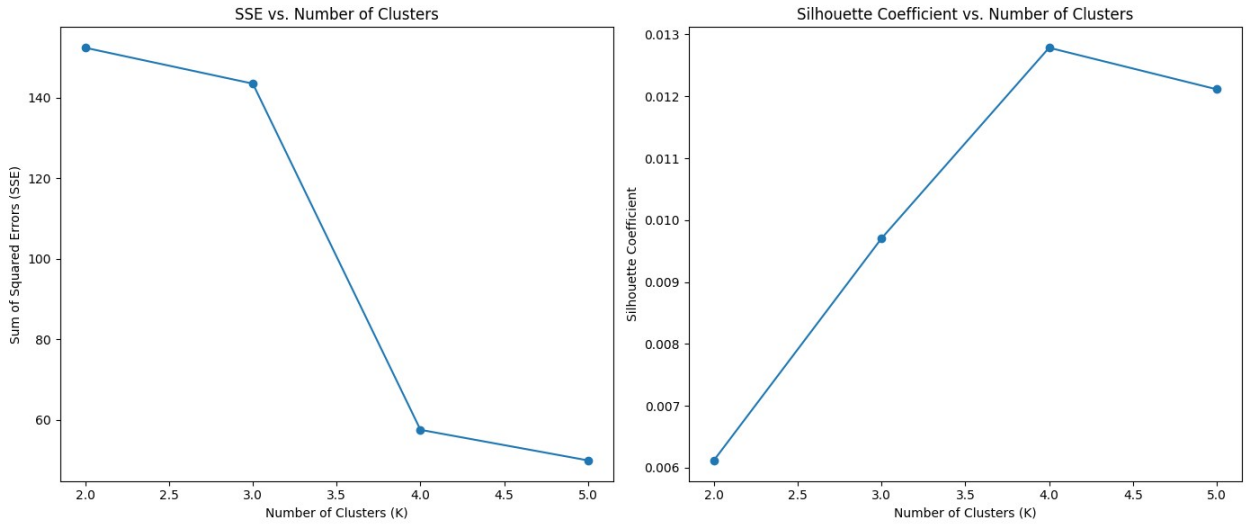
```
for i in range(best_k):
    cluster_points = X[clusters[i]]
    plt.scatter(cluster_points[:, 0], cluster_points[:, 1],
label=f'Cluster {i+1}')
plt.scatter(centroids[:, 0], centroids[:, 1], s=30, c='red',
marker='X', label='Centroids')
plt.title('K-Means Clustering')
plt.legend()
plt.show()
```

```
K     SSE         Silhouette Coefficient     Iterations
2     152.37           0.00612                2
3     78.94       0.00927                4
```

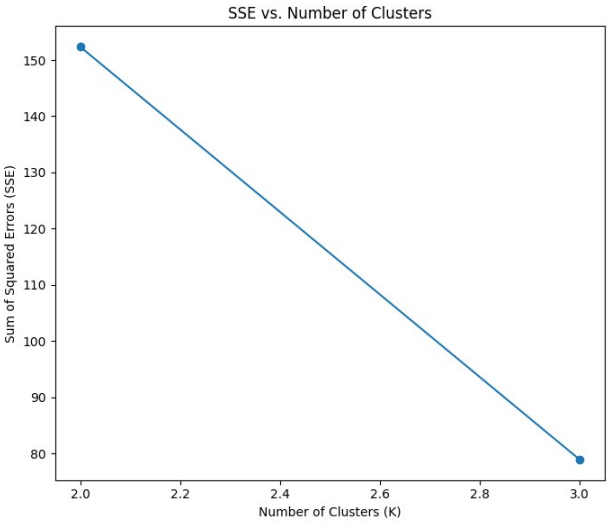


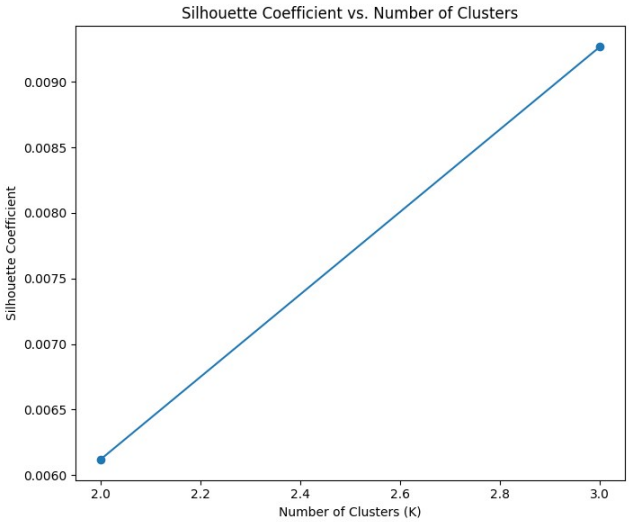

```
k_values = [result[0] for result in results1]
sse_values = [result[1] for result in results1]
silhouette_values = [result[2] for result in results1]

plt.figure(figsize=(14, 6))

plt.subplot(1, 2, 1)
plt.plot(k_values, sse_values, marker='o')
plt.xlabel('Number of Clusters (K)')
plt.ylabel('Sum of Squared Errors (SSE)')
plt.title('SSE vs. Number of Clusters')
```

```
plt.subplot(1, 2, 2)
plt.plot(k_values, silhouette_values, marker='o')
plt.xlabel('Number of Clusters (K)')
plt.ylabel('Silhouette Coefficient')
plt.title('Silhouette Coefficient vs. Number of Clusters')

plt.tight_layout()
plt.show()
```




```
k_values = [result[0] for result in results]
sse_values = [result[1] for result in results]
silhouette_values = [result[2] for result in results]

plt.figure(figsize=(14, 6))

plt.subplot(1, 2, 1)
plt.plot(k_values, sse_values, marker='o')
plt.xlabel('Number of Clusters (K)')
plt.ylabel('Sum of Squared Errors (SSE)')
plt.title('SSE vs. Number of Clusters')

plt.subplot(1, 2, 2)
plt.plot(k_values, silhouette_values, marker='o')
plt.xlabel('Number of Clusters (K)')
plt.ylabel('Silhouette Coefficient')
plt.title('Silhouette Coefficient vs. Number of Clusters')

plt.tight_layout()
plt.show()
```


SSE vs. Number of Clusters
Sum of Squared Errors (SSE)
150
140
130
120
110
100
90
80
2.0
2.2
2.4
2.6
2.8
3.0
Number of Clusters (K)


Silhouette Coefficient vs. Number of Clusters
Silhouette Coefficient
0.0090
0.0085
0.0080
0.0075
0.0070
0.0065
0.0060
2.0
2.2
2.4
2.6
2.8
3.0
Number of Clusters (K)