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In [21]: # Implement K-Means clustering on Iris.csv dataset. Determine the number of cluster
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```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.preprocessing import StandardScaler
from sklearn.cluster import KMeans
```

```
In [22]: iris = pd.read_csv('Iris.csv')
iris.head()
```

```
Out[22]:
```

	<b>Id</b>	<b>SepalLengthCm</b>	<b>SepalWidthCm</b>	<b>PetalLengthCm</b>	<b>PetalWidthCm</b>	<b>Species</b>
<b>0</b>	1	5.1	3.5	1.4	0.2	Iris-setosa
<b>1</b>	2	4.9	3.0	1.4	0.2	Iris-setosa
<b>2</b>	3	4.7	3.2	1.3	0.2	Iris-setosa
<b>3</b>	4	4.6	3.1	1.5	0.2	Iris-setosa
<b>4</b>	5	5.0	3.6	1.4	0.2	Iris-setosa

```
In [23]: iris.isnull().sum()
```

```
Out[23]:
```

<b>Id</b>	0
<b>SepalLengthCm</b>	0
<b>SepalWidthCm</b>	0
<b>PetalLengthCm</b>	0
<b>PetalWidthCm</b>	0
<b>Species</b>	0
<b>dtype: int64</b>	

```
In [24]: iris.shape
```

```
Out[24]: (150, 6)
```

```
In [25]: # Exclude the first column (id) and the last column (species)
X = iris.iloc[:, 1:5]
X.head()
```

```
Out[25]:
```

	<b>SepalLengthCm</b>	<b>SepalWidthCm</b>	<b>PetalLengthCm</b>	<b>PetalWidthCm</b>
<b>0</b>	5.1	3.5	1.4	0.2
<b>1</b>	4.9	3.0	1.4	0.2
<b>2</b>	4.7	3.2	1.3	0.2
<b>3</b>	4.6	3.1	1.5	0.2
<b>4</b>	5.0	3.6	1.4	0.2

```
In [26]: # Standardization
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
X_scaled = pd.DataFrame(X_scaled, columns=X.columns)
X_scaled.head()
```

```
Out[26]:
```

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
0	-0.900681	1.032057	-1.341272	-1.312977
1	-1.143017	-0.124958	-1.341272	-1.312977
2	-1.385353	0.337848	-1.398138	-1.312977
3	-1.506521	0.106445	-1.284407	-1.312977
4	-1.021849	1.263460	-1.341272	-1.312977

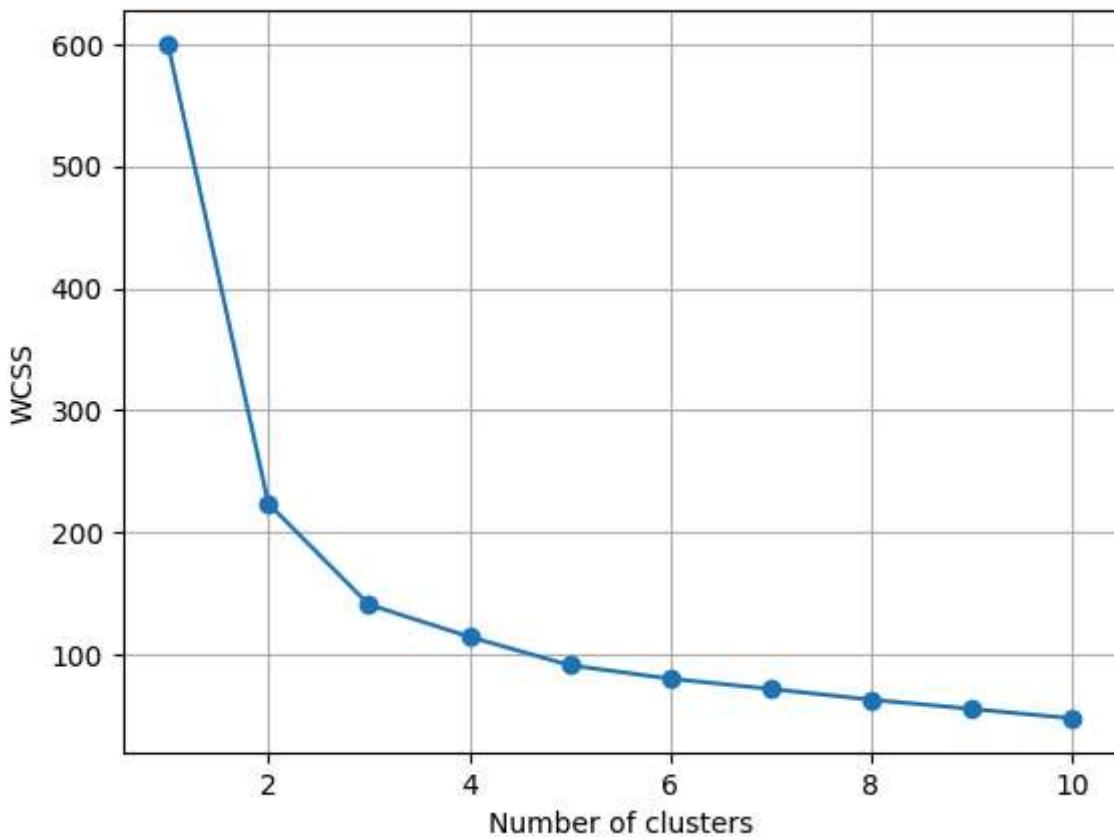
```
In [27]: # Determine the optimal number of clusters using the elbow method

wcss = []
for i in range(1, 11):
    kmeans = KMeans(n_clusters=i, init='k-means++', max_iter=300, n_init=10, random_state=42)
    kmeans.fit(X_scaled)
    wcss.append(kmeans.inertia_)
    print(f'WCSS for {i} clusters: {wcss[-1]}')

WCSS for 1 clusters: 600.0
WCSS for 2 clusters: 223.73200573676345
WCSS for 3 clusters: 140.96581663074699
WCSS for 4 clusters: 114.61550694959807
WCSS for 5 clusters: 91.19197002146464
WCSS for 6 clusters: 80.23060704506958
WCSS for 7 clusters: 71.80147182347547
WCSS for 8 clusters: 63.01282906393716
WCSS for 9 clusters: 55.42759219362284
WCSS for 10 clusters: 47.70295211830704
```

```
In [28]: plt.plot(range(1, 11), wcss, marker='o')
plt.title('Elbow Method')
plt.xlabel('Number of clusters')
plt.ylabel('WCSS')
plt.grid()
plt.show()
```

Elbow Method



```
In [29]: optimal_k = 3
kmeans = KMeans(
    n_clusters=optimal_k,
    init='k-means++',
    max_iter=300,
    n_init=10,
    random_state=0
)
kmeans.fit(X_scaled)
```

```
Out[29]: ▾          KMeans          ⓘ ⓘ
KMeans(n_clusters=3, n_init=10, random_state=0)
```

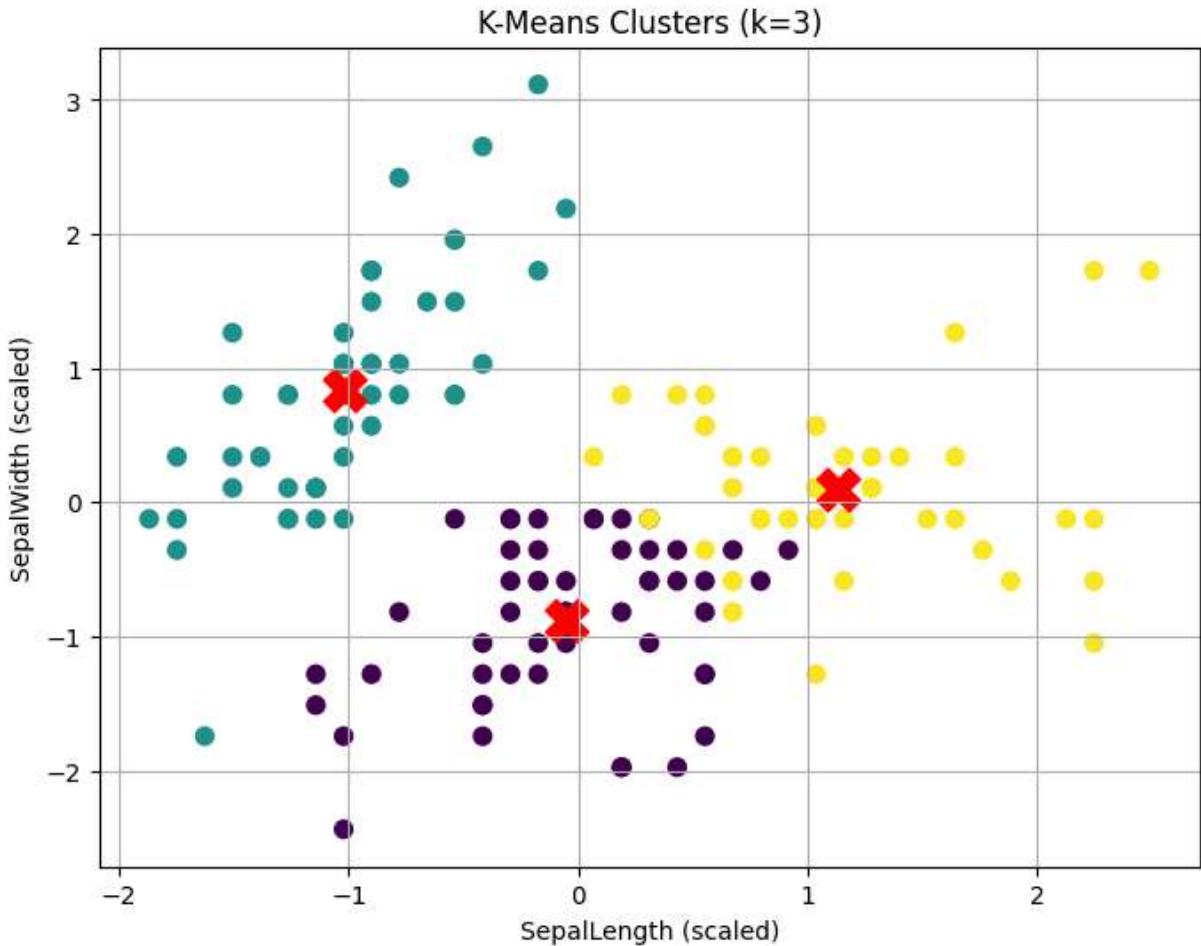
```
In [30]: # Add cluster labels to the original data
iris['Cluster'] = kmeans.labels_
print(iris.head())
```

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species	\
0	1	5.1	3.5	1.4	0.2	Iris-setosa	
1	2	4.9	3.0	1.4	0.2	Iris-setosa	
2	3	4.7	3.2	1.3	0.2	Iris-setosa	
3	4	4.6	3.1	1.5	0.2	Iris-setosa	
4	5	5.0	3.6	1.4	0.2	Iris-setosa	

	Cluster
0	1
1	1
2	1
3	1
4	1

```
In [ ]: # Visualize the clusters
plt.figure(figsize=(8,6))
plt.scatter(
    X_scaled.iloc[:, 0], X_scaled.iloc[:, 1],
    c=iris['Cluster'], cmap='viridis', s=50
)
plt.scatter(
    kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1],
    marker='X', s=300, c='red', linewidths=1
)
plt.xlabel('SepalLength (scaled)')
plt.ylabel('SepalWidth (scaled)')
plt.title(f'K-Means Clusters (k={optimal_k})')
plt.grid()
plt.show()
```



```
In [32]: # Map clusters to species for comparison (useful for analysis)
species_map = {0: 'Setosa', 1: 'Versicolor', 2: 'Virginica'}
iris['Species_Label'] = iris['Species'] # Original Label
print(pd.crosstab(iris['Cluster'], iris['Species_Label']))
```

	Species_Label	Iris-setosa	Iris-versicolor	Iris-virginica
Cluster				
0		0	39	14
1		50	0	0
2		0	11	36

```
In [34]: # split data for model training
X = X_scaled
y = iris['Cluster']
```

```
In [35]: #train model
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Train a Random Forest classifier
rf_model = RandomForestClassifier(n_estimators=100, random_state=42)
rf_model.fit(X_train, y_train)
```

```
# Make predictions on the test set
y_pred = rf_model.predict(X_test)

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy: {accuracy:.2f}")
```

Accuracy: 0.93