MACHINE LEARNING
Assignment 8
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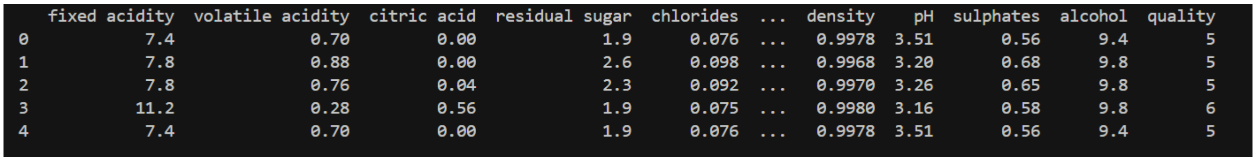
A1 09

Implement the K-Means algorithm using the Wine dataset

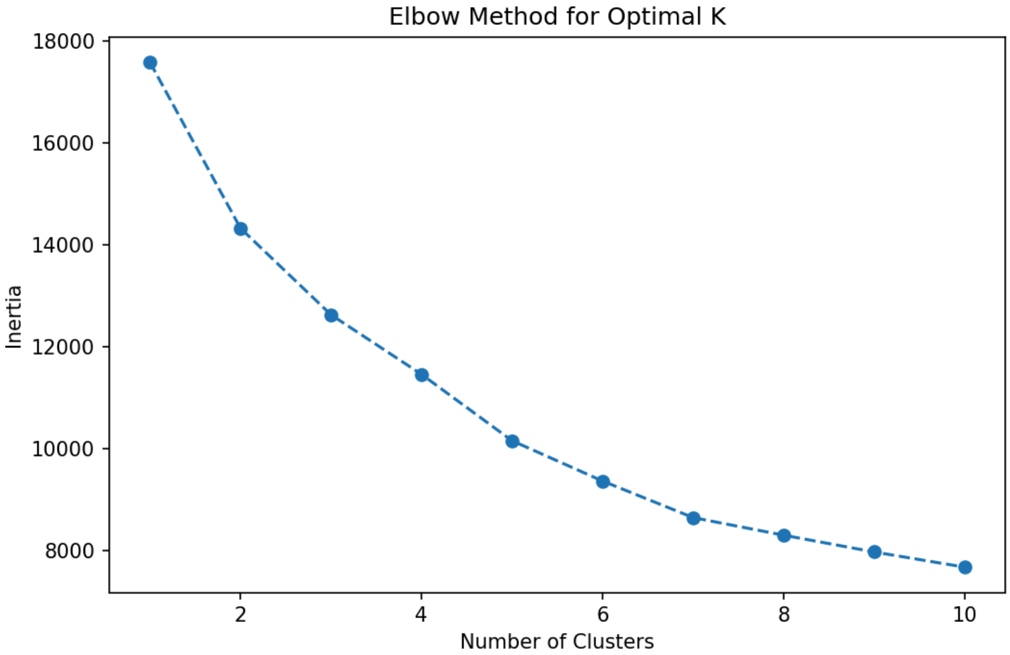
CODE:

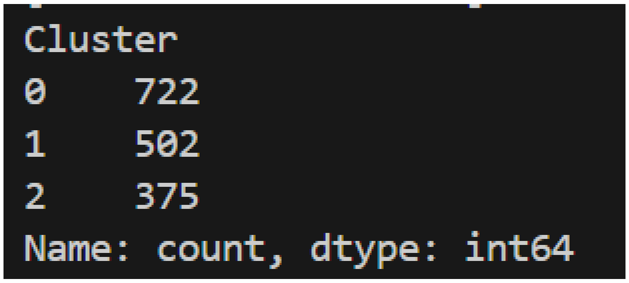
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA

# Load the dataset
file_path = "wine_dataset.csv"  # Update this with your actual dataset file path
df = pd.read_csv(file_path)

# Display basic info
display(df.head())

# Features selection (excluding 'quality' if present as it's categorical)
X = df.drop(columns=["quality"], errors='ignore')

# Standardize the data
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Determine optimal K using Elbow Method
inertia = []
k_range = range(1, 11)
for k in k_range:
    kmeans = KMeans(n_clusters=k, random_state=42, n_init=10)
    kmeans.fit(X_scaled)
    inertia.append(kmeans.inertia_)

# Plot Elbow Graph
plt.figure(figsize=(8, 5))
plt.plot(k_range, inertia, marker='o', linestyle='--')
plt.xlabel("Number of Clusters")
plt.ylabel("Inertia")
plt.title("Elbow Method for Optimal K")
plt.show()

# Fit K-Means with optimal K (assuming 3 for example)
kmeans = KMeans(n_clusters=3, random_state=42, n_init=10)
df['Cluster'] = kmeans.fit_predict(X_scaled)

# Perform PCA for visualization
pca = PCA(n_components=2)
X_pca = pca.fit_transform(X_scaled)
df['PCA1'] = X_pca[:, 0]
df['PCA2'] = X_pca[:, 1]

# Scatter plot of clusters
plt.figure(figsize=(8, 6))
plt.scatter(df['PCA1'], df['PCA2'], c=df['Cluster'], cmap='viridis', alpha=0.7)
plt.xlabel("Principal Component 1")
plt.ylabel("Principal Component 2")
plt.title("K-Means Clustering Visualization")
plt.colorbar(label='Cluster')
plt.show()

# Display cluster counts
print(df['Cluster'].value_counts())
```

OUTPUT:

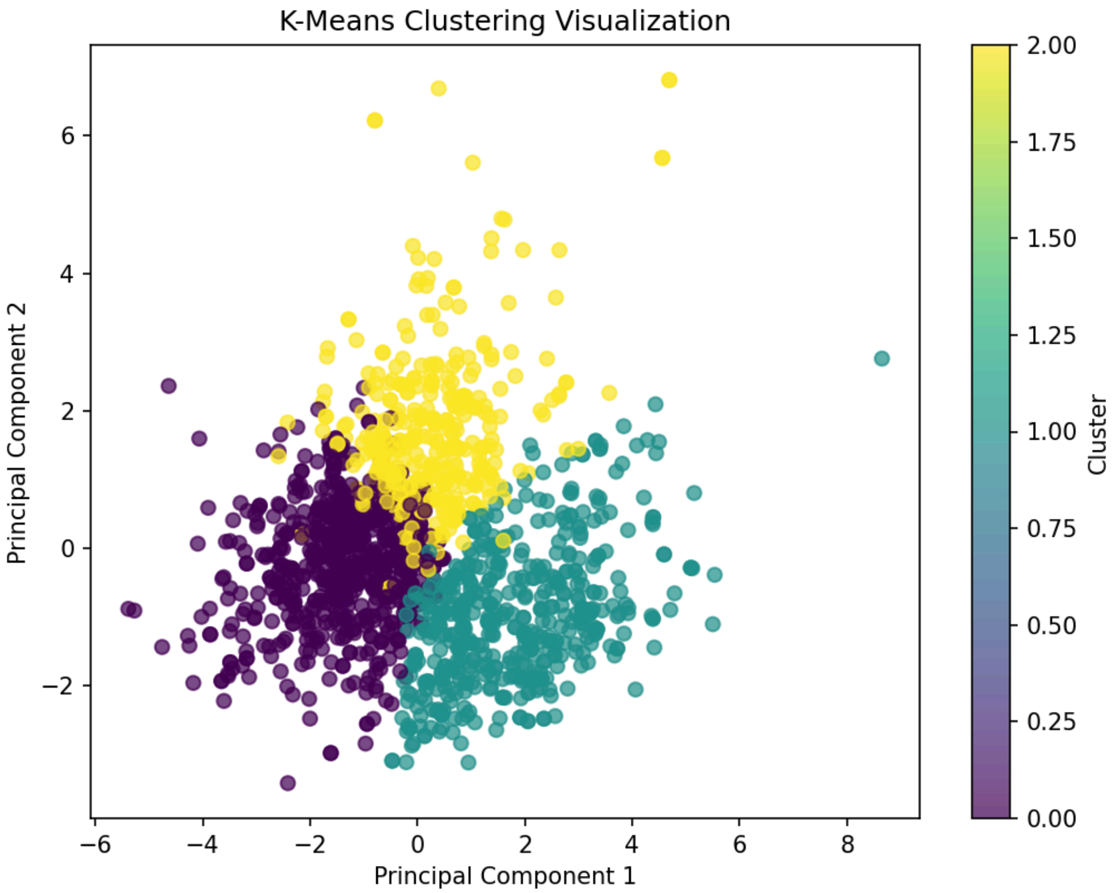


```
   fixed acidity  volatile acidity  citric acid  residual sugar  chlorides  ...  density    pH  sulphates  alcohol  quality
0            7.4              0.70         0.00             1.9      0.076  ...   0.9978  3.51       0.56      9.4        5
1            7.8              0.88         0.00             2.6      0.098  ...   0.9968  3.20       0.68      9.8        5
2            7.8              0.76         0.04             2.3      0.092  ...   0.9970  3.26       0.65      9.8        5
3           11.2              0.28         0.56             1.9      0.075  ...   0.9980  3.16       0.58      9.8        6
4            7.4              0.70         0.00             1.9      0.076  ...   0.9978  3.51       0.56      9.4        5
```





```
Cluster
0    722
1    502
2    375
Name: count, dtype: int64
```


K-Means Clustering Visualization
Principal Component 1
Principal Component 2
−6
−4
−2
0
2
4
6
8
6
4
2
0
−2
Cluster
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00