K-Means Clustering Implementation

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Change Log

SL No.	Change Category	Description	Duration (mins)	Difficulty (1-10)
1	Dataset Change	Replaced Iris dataset with the Penguins dataset.	10	3
2	Data Processing	Dropped missing values and encoded categorical target variables.	15	4
3	Feature Selection	Used `bill_length_mm` and `bill_depth_mm` as features instead of PCA-transformed features.	10	3
4	Logging Integration	Added `logging` for better tracking of process execution.	20	5
5	Hyperparameter Tuning	Expanded `n_neighbors` search range from [1,3,5] to [1, 20].	25	6
6	Performance Metrics	Used `accuracy_score` for evaluation instead of direct `classification_report`.	10	3
7	Visualization	Implemented decision boundary plotting using `matplotlib` and `seaborn`.	30	7
8	Dummy Classifier Removal	Removed `DummyClassifier` comparison for simplicity.	5	2

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import logging
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score
from sklearn.preprocessing import StandardScaler
```

In [2]:
```
logging.basicConfig(level=logging.INFO, format='%(asctime)s - %(levelname)s - %(
```

In [3]:
```
# Step 1: Business Understanding
logging.info("Business Understanding: Applying K-Means Clustering to identify da
```

```
2025-02-19 12:20:29,476 - INFO - Business Understanding: Applying K-Means Clustering to identify data patterns.
```

In [5]:
```
# Step 2: Data Understanding
logging.info("Loading dataset...")
data = sns.load_dataset('penguins').dropna()
logging.info(f"Dataset loaded with shape {data.shape}")
```

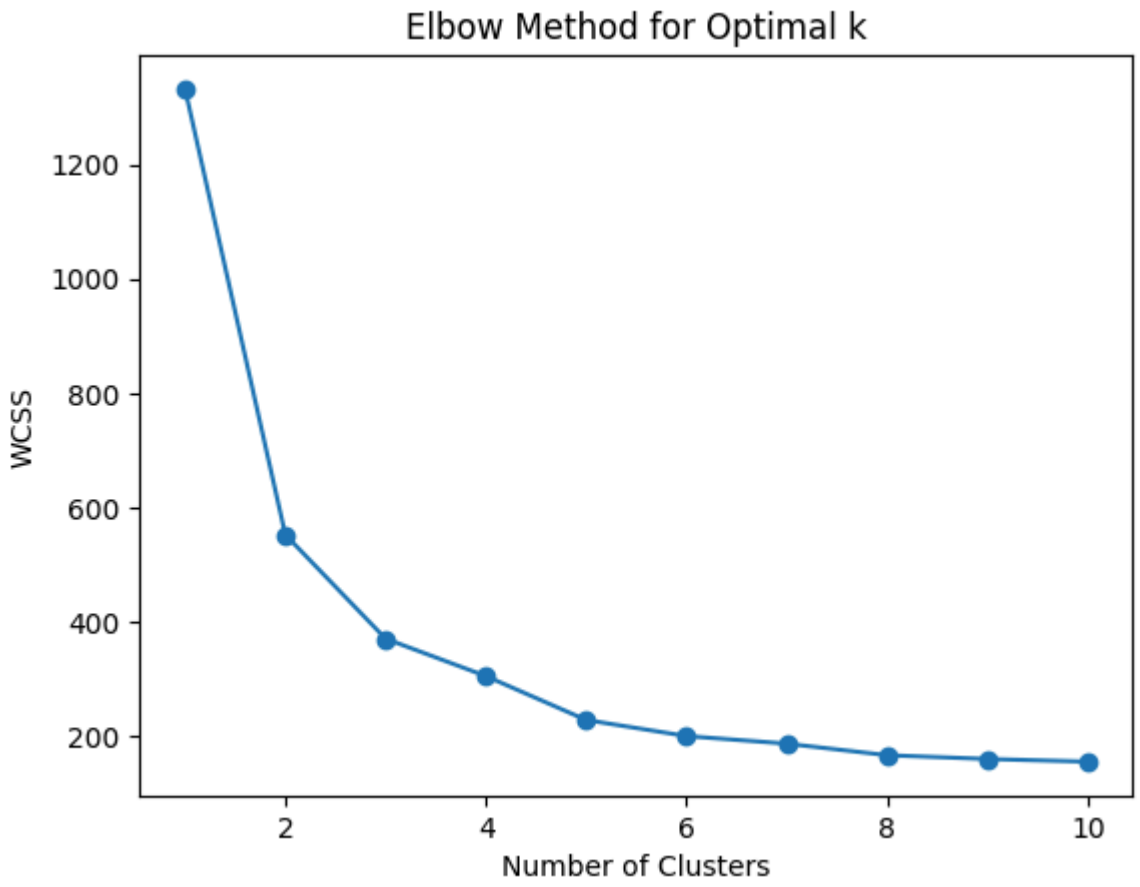
```
2025-02-19 12:21:14,277 - INFO - Loading dataset...
2025-02-19 12:21:15,766 - INFO - Dataset loaded with shape (333, 7)
```

In [6]:
```
# Selecting numerical features
X = data[['bill_length_mm', 'bill_depth_mm', 'flipper_length_mm', 'body_mass_g']]
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
logging.info("Data scaled successfully.")
```

```
2025-02-19 12:21:53,959 - INFO - Data scaled successfully.
```

In [7]:
```
# Step 3: Finding Optimal k
wcss = []
k_values = range(1, 11)
for k in k_values:
    kmeans = KMeans(n_clusters=k, random_state=42)
    kmeans.fit(X_scaled)
    wcss.append(kmeans.inertia_)

plt.plot(k_values, wcss, marker='o')
plt.title("Elbow Method for Optimal k")
plt.xlabel("Number of Clusters")
plt.ylabel("WCSS")
plt.show()
```



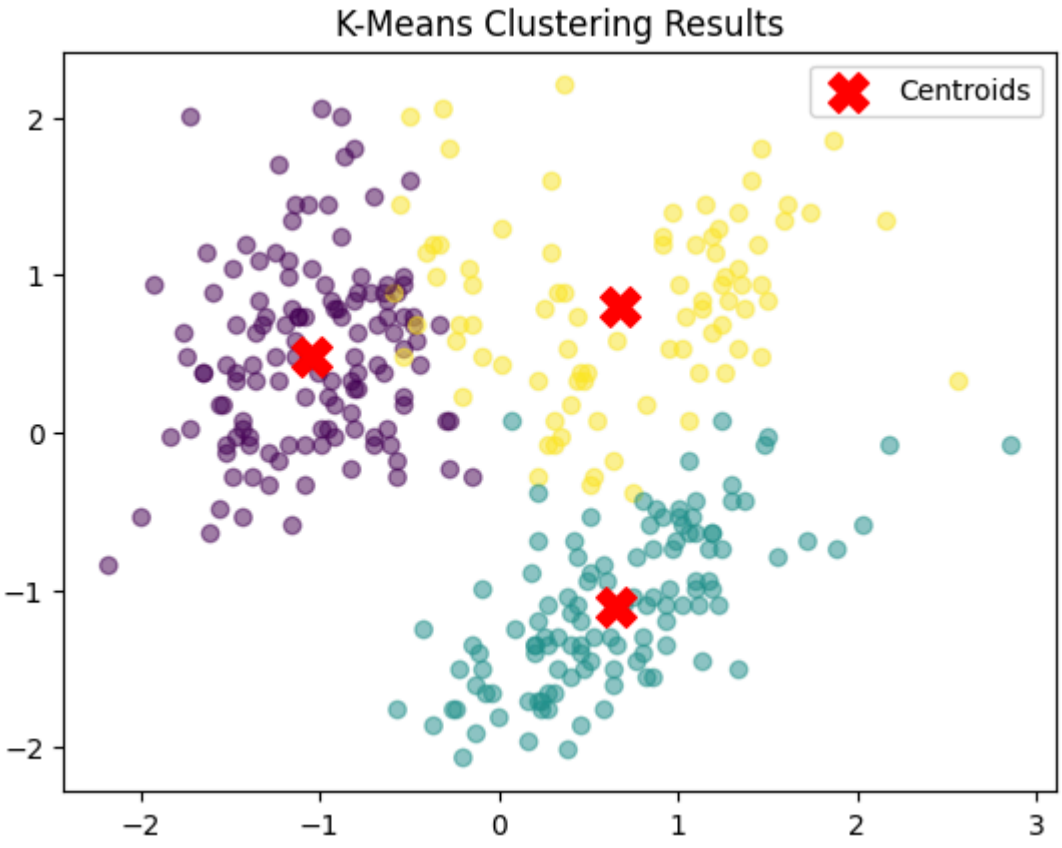
In [8]:
```
# Step 4: Training K-Means Model
optimal_k = 3  # Chosen based on Elbow Method
logging.info(f"Optimal number of clusters selected: {optimal_k}")
kmeans = KMeans(n_clusters=optimal_k, random_state=42)
labels = kmeans.fit_predict(X_scaled)

# Step 5: Evaluation
sil_score = silhouette_score(X_scaled, labels)
logging.info(f"Silhouette Score: {sil_score:.4f}")
```

```
2025-02-19 12:23:26,376 - INFO - Optimal number of clusters selected: 3
2025-02-19 12:23:26,415 - INFO - Silhouette Score: 0.4462
```

In [9]:
```
plt.scatter(X_scaled[:, 0], X_scaled[:, 1], c=labels, cmap='viridis', alpha=0.5)
plt.scatter(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1], s=200,
plt.title("K-Means Clustering Results")
plt.legend()
plt.show()

logging.info("K-Means clustering completed successfully.")
```




```
2025-02-19 12:24:07,402 - INFO - K-Means clustering completed successfully.
```