Internet Usage Clustering

A PROJECT REPORT

Submitted by

SATWIK SHAW

20240110030021 7

Introduction

This project aims to group internet users based on their browsing habits. Clustering allows us to analyze users with similar usage patterns, which is helpful in behavior prediction, service customization, and anomaly detection. We use KMeans clustering for this unsupervised learning task, based on three key attributes: time spent online daily, variety of sites visited, and the number of sessions per day

Methodology

a. Dataset
The dataset used contains:

- daily_usage_hours: Time (in hours) spent online per day.
- site_categories_visited: Number of different categories of websites accessed.
- sessions_per_day: Count of browsing sessions per day.

b. Data Preprocessing
All features were standardized using StandardScaler from scikit-learn to remove scale-related bias in clustering.

c. Clustering Algorithm
We used **KMeans**, a centroid-based unsupervised learning algorithm.

- The **Elbow Method** helped determine the optimal number of clusters (k=3).
- Model initialized with random_state=42 for reproducibility.

d. Evaluation
The **Silhouette Score** was used to measure how well samples were clustered with similar ones, with a value of **0.30** indicating reasonable separation.

e. Visualization
Clusters were plotted on a 2D scatter plot
using matplotlib and seaborn. The plot visualized session frequency vs daily usage time for each user

Code

```
# Internet Usage Clustering using KMeans

# Import necessary libraries
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import StandardScaler
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score

# Step 1: Load the dataset
file_path = 'internet_usage.csv'  # Make sure the CSV is uploaded to Colab
df = pd.read_csv(file_path)

# Step 2: Display basic information
print("First few rows of the dataset:")
print(df.head())

# Step 3: Feature scaling using StandardScaler
scaler = StandardScaler()
scaled_features = scaler.fit_transform(df)

# Step 4: Determine the optimal number of clusters (Elbow Method)
inertia = []
range_n_clusters = range(2, 10)

for k in range_n_clusters:
    kmeans = KMeans(n_clusters=k, random_state=42, n_init=10)
```

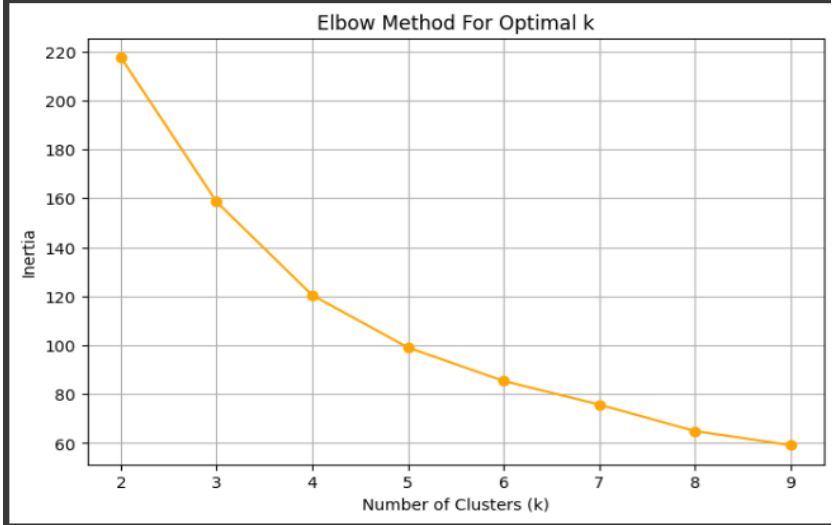
```
    kmeans.fit(scaled_features)
    inertia.append(kmeans.inertia_)

# Plot the Elbow Curve
plt.figure(figsize=(8, 5))
plt.plot(range_n_clusters, inertia, marker='o', color='orange')
plt.title("Elbow Method For Optimal k")
plt.xlabel("Number of Clusters (k)")
plt.ylabel("Inertia")
plt.grid(True)
plt.show()

# Step 5: Apply KMeans with optimal k (chosen as 3)
k = 3
kmeans = KMeans(n_clusters=k, random_state=42, n_init=10)
df['Cluster'] = kmeans.fit_predict(scaled_features)

# Step 6: Evaluate with silhouette score
sil_score = silhouette_score(scaled_features, df['Cluster'])
print(f"Silhouette Score for k={k}: {sil_score:.2f}")

# Step 7: Visualize the clusters
plt.figure(figsize=(8, 6))
sns.scatterplot(
    data=df,
    x='daily_usage_hours',
    y='sessions_per_day',
    hue='Cluster',
    palette='Set2',
```

```
    s=100
)
plt.title(f'Internet Usage Clustering (k={k})\nSilhouette Score = {sil_score:.2f}')
plt.xlabel('Daily Usage (hours)')
plt.ylabel('Sessions per Day')
plt.legend(title='Cluster')
plt.grid(True)
plt.show()
```

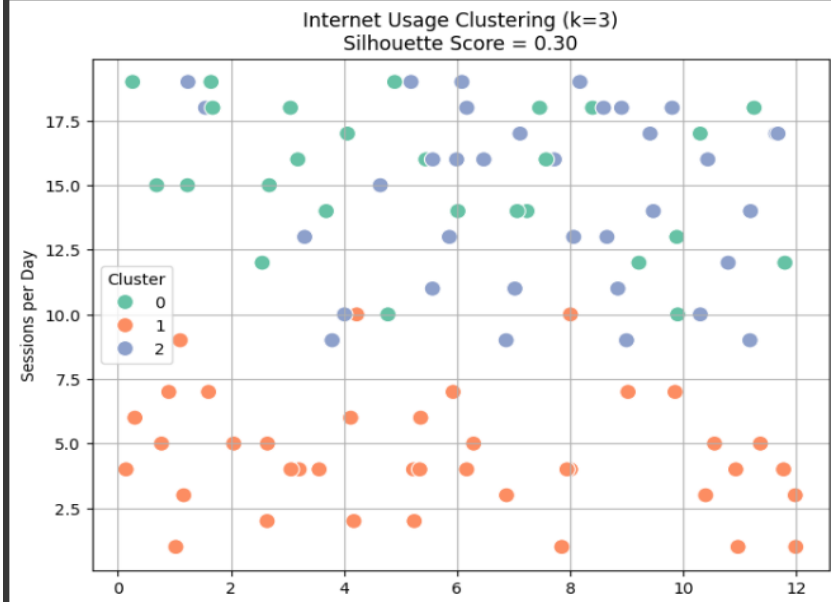
Output / Result

- **Optimal Clusters**: 3
- **Silhouette Score**: 0.30
- **Cluster Insights**:
  - Cluster 0: Light internet users
  - Cluster 1: Heavy users (long sessions)
  - Cluster 2: Moderate users
-

```
First few rows of the dataset:
   daily_usage_hours  site_categories_visited  sessions_per_day
0           9.884957                        2                13
1           1.023220                        9                 1
2          10.394205                        9                 3
3           5.990237                        6                16
4           3.558451                        4                 4
```




```
Silhouette Score for k=3: 0.30
```



References / Credits

- Scikit-learn Documentation: https://scikit-learn.org
- Matplotlib & Seaborn for visualization
- Dataset provided by Instructor/University