vl1ueptud

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1 Clustering

Importing Necessary Libraries

[ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
from sklearn.cluster import DBSCAN
from sklearn.decomposition import PCA
from sklearn.neighbors import NearestNeighbors
from sklearn.preprocessing import StandardScaler
```

Data Pre-processing

[ ]:
```
dataset = pd.read_csv('data.csv')
```

[ ]:
```
dataset
```

[ ]:
```
          id     f_00      f_01      f_02      f_03      f_04      f_05  \
0          0 -0.389420 -0.912791  0.648951  0.589045 -0.830817  0.733624
1          1 -0.689249 -0.453954  0.654175  0.995248 -1.653020  0.863810
2          2  0.809079  0.324568 -1.170602 -0.624491  0.105448  0.783948
3          3 -0.500923  0.229049  0.264109  0.231520  0.415012 -1.221269
4          4 -0.671268 -1.039533 -0.270155 -1.830264 -0.290108 -1.852809
…        …        …        …        …        …        …        …
11778  11778 -0.158279  1.858053 -0.921248 -1.429355 -0.764838 -1.589881
11779  11779  1.525135 -0.607098 -1.150169  0.097532  0.080528 -0.455163
11780  11780 -0.620387 -0.571274 -0.055193 -1.439184  0.453599  1.753876
11781  11781  0.508547 -1.457904 -1.744796 -1.463034 -1.262898 -0.636495
11782  11782  0.650153 -0.082629 -1.447581  0.432188  0.882758 -0.525402

           f_06  f_07  f_08  …      f_19      f_20      f_21      f_22  \
0      2.258560     2    13  … -0.478412 -0.757002 -0.763635 -1.090369
1     -0.090651     2     3  … -0.428791 -0.089908 -1.784204 -0.839474
2      1.988301     5    11  … -0.413534 -1.602377  1.190984  3.267116
3      0.138850     6     2  …  0.619283  1.287801  0.532837  1.036631
4      0.781898     8     7  … -1.628830 -0.434948  0.322505  0.284326
```

```
…          …    …    …   …        …         …         …         …
11778 -1.040811    10     0   … -0.348376 -0.869971  2.027264  3.412598
11779 -0.789688     0     8   …  1.921439 -1.081978  0.755980  0.535688
11780 -0.123739     1     7   … -0.698945  1.263422 -1.094891 -3.188875
11781  1.013085     2     4   …  1.243519  1.027125 -0.031330 -3.912239
11782  0.241355    10     6   …       NaN       NaN       NaN       NaN

           f_23      f_24      f_25      f_26      f_27      f_28
0      1.142641 -0.884274  1.137896  1.309073  1.463002  0.813527
1      0.459685  1.759412 -0.275422 -0.852168  0.562457 -2.680541
2     -0.088322 -2.168635 -0.974989  1.335763 -1.110655 -3.630723
3     -2.041828  1.440490 -1.900191 -0.630771 -0.050641  0.238333
4     -2.438365  1.473930 -1.044684  1.602686 -0.405263 -1.987263
…           …       …       …       …       …       …
11778 -0.064369 -2.231076  1.034084  0.973716  0.578975  0.961858
11779 -1.206252  1.457501  1.384902  0.079117  1.583883 -0.010434
11780  1.365082 -0.042190 -0.127365 -0.341521 -0.650510  2.074136
11781  0.804292 -0.280057  0.873512 -0.340227  0.699506  0.205752
11782       NaN       NaN       NaN       NaN       NaN       NaN

[11783 rows x 30 columns]
```

[ ]:

```
dataset.isna().sum()
```

[ ]:

```
id      0
f_00    0
f_01    0
f_02    0
f_03    0
f_04    0
f_05    0
f_06    0
f_07    0
f_08    0
f_09    0
f_10    0
f_11    0
f_12    0
f_13    0
f_14    0
f_15    1
f_16    1
f_17    1
f_18    1
f_19    1
f_20    1
f_21    1
```

```
f_22    1
f_23    1
f_24    1
f_25    1
f_26    1
f_27    1
f_28    1
dtype: int64
```

[ ]:
```
dataset.shape
```

[ ]:
```
(11783, 30)
```

[ ]:
```
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 11783 entries, 0 to 11782
Data columns (total 30 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   id      11783 non-null  int64
 1   f_00    11783 non-null  float64
 2   f_01    11783 non-null  float64
 3   f_02    11783 non-null  float64
 4   f_03    11783 non-null  float64
 5   f_04    11783 non-null  float64
 6   f_05    11783 non-null  float64
 7   f_06    11783 non-null  float64
 8   f_07    11783 non-null  int64
 9   f_08    11783 non-null  int64
 10  f_09    11783 non-null  int64
 11  f_10    11783 non-null  int64
 12  f_11    11783 non-null  int64
 13  f_12    11783 non-null  int64
 14  f_13    11783 non-null  int64
 15  f_14    11783 non-null  float64
 16  f_15    11782 non-null  float64
 17  f_16    11782 non-null  float64
 18  f_17    11782 non-null  float64
 19  f_18    11782 non-null  float64
 20  f_19    11782 non-null  float64
 21  f_20    11782 non-null  float64
 22  f_21    11782 non-null  float64
 23  f_22    11782 non-null  float64
 24  f_23    11782 non-null  float64
 25  f_24    11782 non-null  float64
 26  f_25    11782 non-null  float64
```

```
 27   f_26    11782 non-null  float64
 28   f_27    11782 non-null  float64
 29   f_28    11782 non-null  float64
dtypes: float64(22), int64(8)
memory usage: 2.7 MB
```

[ ]:
```
dataset.dropna(inplace=True)
```

[ ]:
```
dataset.drop('id', axis=1, inplace=True)
```

[ ]:
```
scaler = StandardScaler()
scaled_df = scaler.fit_transform(dataset)

df_scaled = pd.DataFrame(scaled_df, columns=dataset.columns)

df_scaled.head()
```

[ ]:
```
       f_00      f_01      f_02      f_03      f_04      f_05      f_06  \
0 -0.387661 -0.910925  0.646339  0.593247 -0.827513  0.742537  2.259595
1 -0.687692 -0.456304  0.651517  0.998566 -1.646285  0.872187 -0.094171
2  0.811646  0.315062 -1.157490 -0.617645  0.104846  0.792654  1.988812
3 -0.499240  0.220421  0.264822  0.236501  0.413118 -1.204295  0.135775
4 -0.669699 -1.036502 -0.264824 -1.820792 -0.289060 -1.833230  0.780070

       f_07      f_08      f_09  …      f_19      f_20      f_21      f_22  \
0 -0.966957  1.495756  0.985589  … -0.470556 -0.759687 -0.759855 -0.711374
1 -0.966957 -0.899682 -0.370146  … -0.421218 -0.096589 -1.780561 -0.541965
2 -0.152360  1.016668 -0.539613  … -0.406047 -1.599997  1.195026  2.230884
3  0.119173 -1.139226  0.816123  …  0.620883  1.272866  0.536791  0.724818
4  0.662238  0.058493 -0.539613  … -1.614418 -0.439562  0.326431  0.216847

       f_23      f_24      f_25      f_26      f_27      f_28
0  0.900450 -0.684752  0.765463  0.956962  1.058161  0.682993
1  0.444898  1.025522 -0.135542 -0.548094  0.366201 -1.584807
2  0.079360 -1.515641 -0.581523  0.975549 -0.919385 -2.201516
3 -1.223687  0.819203 -1.171348 -0.393916 -0.104892  0.309668
4 -1.488190  0.840835 -0.625954  1.161430 -0.377376 -1.134840

[5 rows x 29 columns]
```

K-means Clustering

[ ]:
```
# Initialize the KMeans model with the desired number of clusters
kmeans = KMeans(n_clusters=3)
kmeans_cluster = kmeans.fit_predict(df_scaled)
df_scaled['Cluster'] = kmeans_cluster
df_scaled.head()
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
```

[ ]:

```
       f_00      f_01      f_02      f_03      f_04      f_05      f_06  \
0 -0.387661 -0.910925  0.646339  0.593247 -0.827513  0.742537  2.259595
1 -0.687692 -0.456304  0.651517  0.998566 -1.646285  0.872187 -0.094171
2  0.811646  0.315062 -1.157490 -0.617645  0.104846  0.792654  1.988812
3 -0.499240  0.220421  0.264822  0.236501  0.413118 -1.204295  0.135775
4 -0.669699 -1.036502 -0.264824 -1.820792 -0.289060 -1.833230  0.780070

       f_07      f_08      f_09  …      f_20      f_21      f_22      f_23  \
0 -0.966957  1.495756  0.985589  … -0.759687 -0.759855 -0.711374  0.900450
1 -0.966957 -0.899682 -0.370146  … -0.096589 -1.780561 -0.541965  0.444898
2 -0.152360  1.016668 -0.539613  … -1.599997  1.195026  2.230884  0.079360
3  0.119173 -1.139226  0.816123  …  1.272866  0.536791  0.724818 -1.223687
4  0.662238  0.058493 -0.539613  … -0.439562  0.326431  0.216847 -1.488190

       f_24      f_25      f_26      f_27      f_28  Cluster
0 -0.684752  0.765463  0.956962  1.058161  0.682993        2
1  1.025522 -0.135542 -0.548094  0.366201 -1.584807        0
2 -1.515641 -0.581523  0.975549 -0.919385 -2.201516        2
3  0.819203 -1.171348 -0.393916 -0.104892  0.309668        1
4  0.840835 -0.625954  1.161430 -0.377376 -1.134840        0

[5 rows x 30 columns]
```

[ ]:

```python
df_scaled['Cluster'].value_counts()
```

[ ]:

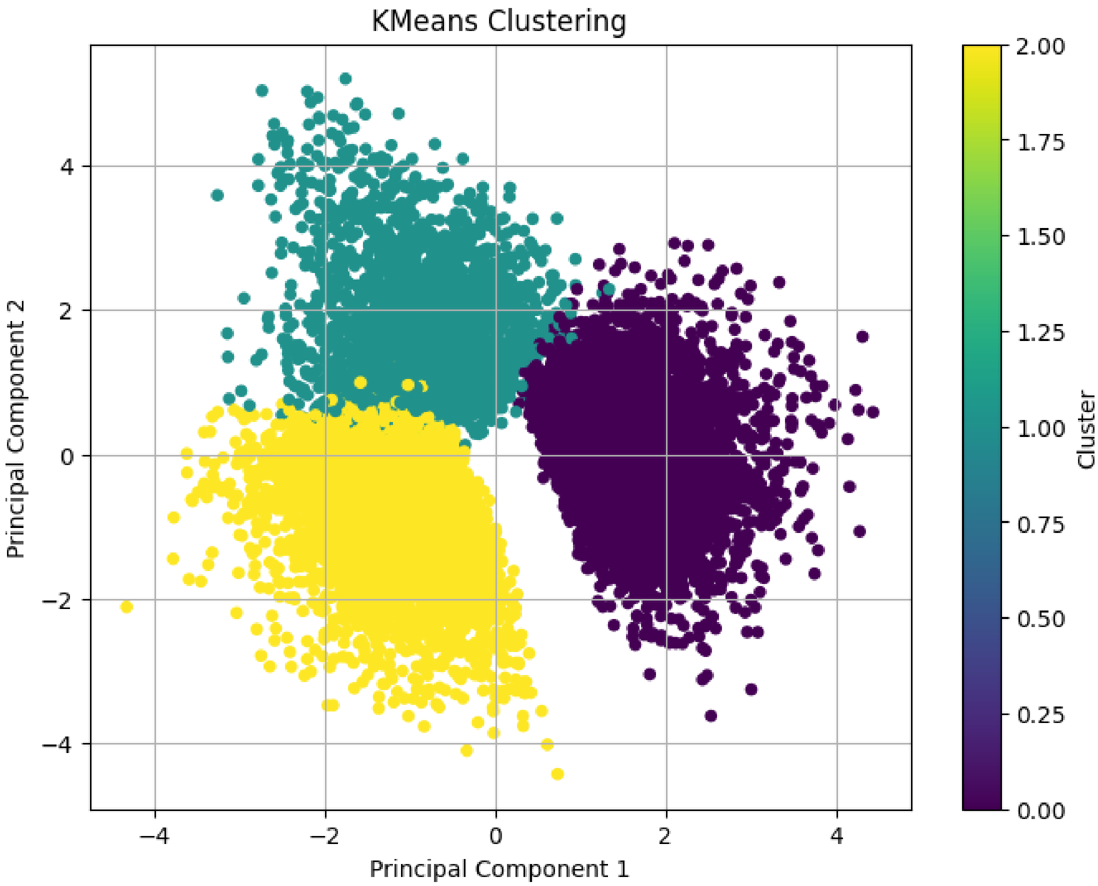
```
Cluster
2    4863
0    4638
1    2281
Name: count, dtype: int64
```

[ ]:

```python
# Reduce the dimensionality of the data using PCA
pca = PCA(n_components=2)
df_pca = pca.fit_transform(df_scaled)

# Plot the clusters
plt.figure(figsize=(8, 6))
plt.scatter(df_pca[:, 0], df_pca[:, 1], c=kmeans_cluster, cmap='viridis', s=20)
plt.title('KMeans Clustering')
plt.xlabel('Principal Component 1')
plt.ylabel('Principal Component 2')
plt.colorbar(label='Cluster')
```

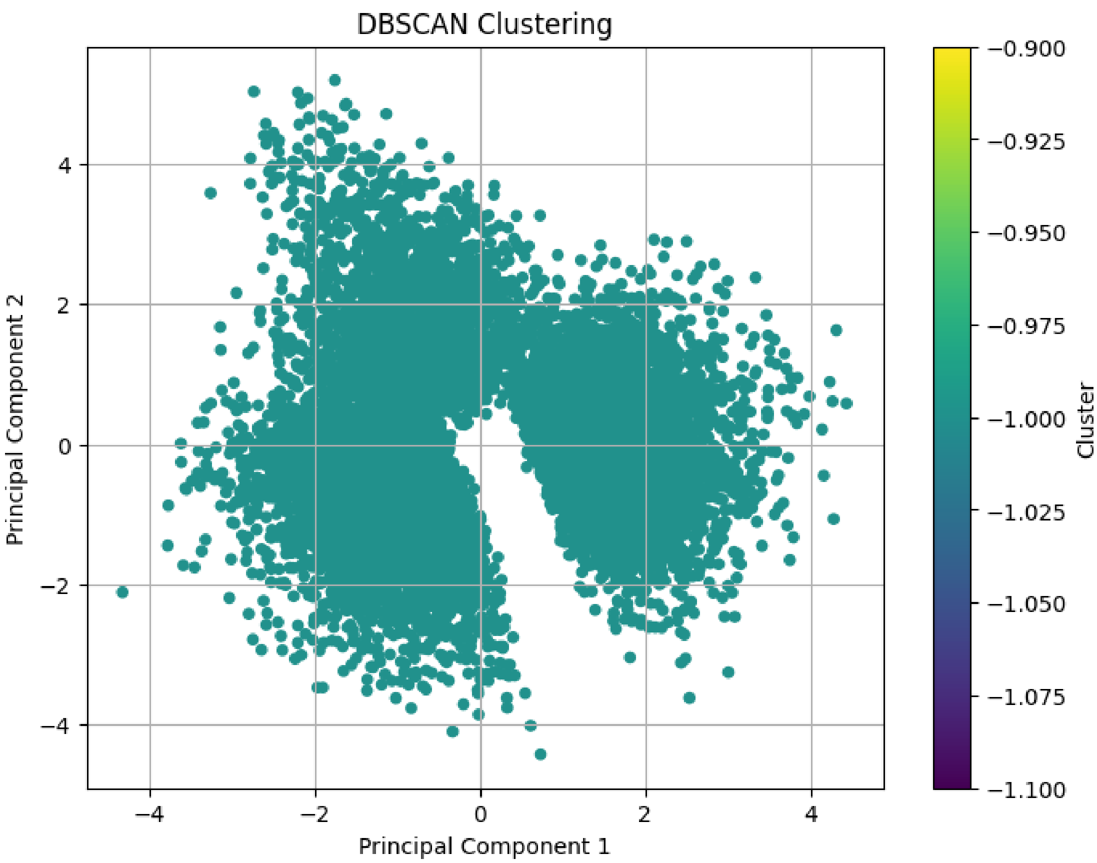
```
plt.grid(True)
plt.show()
```



DBSCAN Clustering

[ ]:
```
dbscan = DBSCAN(eps=0.25, min_samples=5)
dbscan_cluster = dbscan.fit_predict(df_scaled)
```

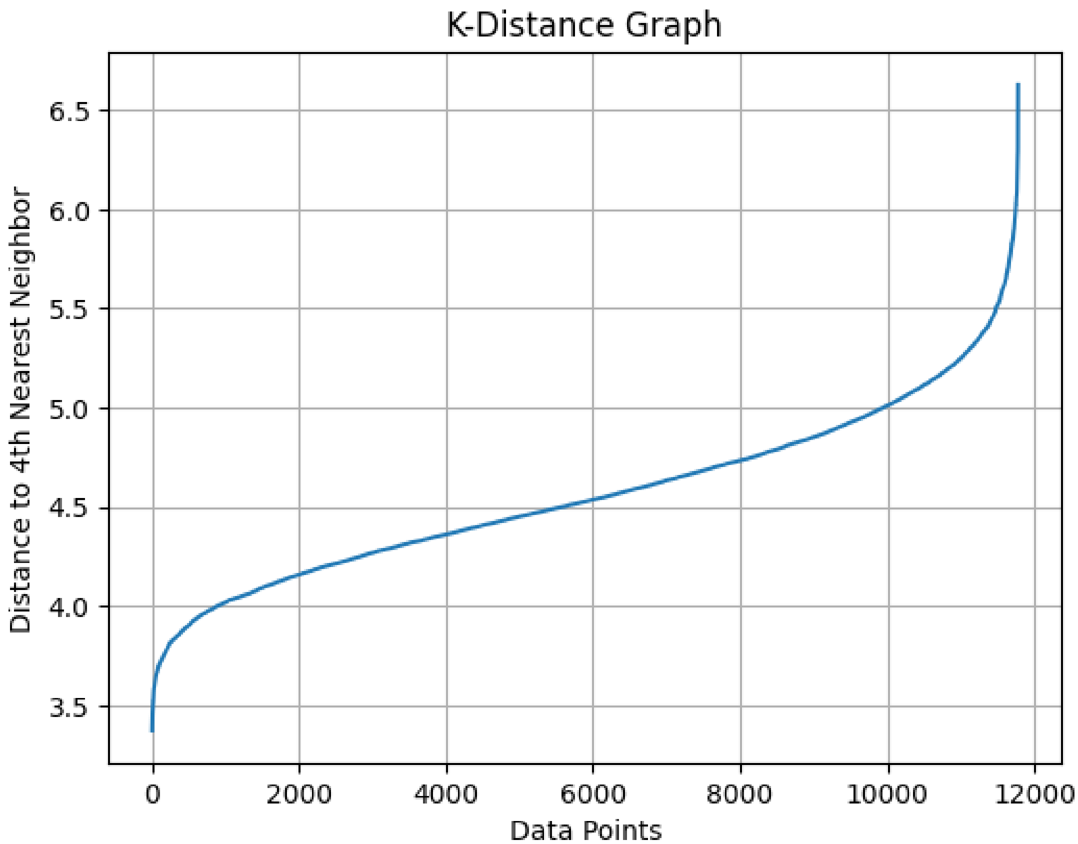
[ ]:
```
plt.figure(figsize=(8, 6))
plt.scatter(df_pca[:, 0], df_pca[:, 1], c=dbscan_cluster, cmap='viridis', s=20)
plt.title('DBSCAN Clustering')
plt.xlabel('Principal Component 1')
plt.ylabel('Principal Component 2')
plt.colorbar(label='Cluster')
plt.grid(True)
plt.show()
```



KNN Clustering

```
[ ]: # Compute the k-nearest neighbors of each data point
k = 4  # Choose an appropriate value of k
neigh = NearestNeighbors(n_neighbors=k)
neigh.fit(df_scaled)
distances, _ = neigh.kneighbors(df_scaled)

# Sort the distances and plot the k-distance graph
sorted_distances = np.sort(distances[:, -1])
plt.plot(np.arange(len(df_scaled)), sorted_distances)
plt.xlabel('Data Points')
plt.ylabel(f'Distance to {k}th Nearest Neighbor')
plt.title('K-Distance Graph')
plt.grid(True)
plt.show()
```


K-Distance Graph
Distance to 4th Nearest Neighbor
6.5
6.0
5.5
5.0
4.5
4.0
3.5
0
2000
4000
6000
8000
10000
12000
Data Points

[ ]: