Spring 2023: CS5710 – Machine Learning

In-Class Programming Assignment-5

GitHub Link - https://github.com/raimukul/MachineLearning_Assignments/tree/main/Assignment%2005

Video link-
https://drive.google.com/file/d/13cmfNAbHYzUXgphNMItYNpi80udNLryJ/view?usp=share_link

Code:

1. Principal Component Analysis

    a. Apply PCA on CC dataset.

    b. Apply k-means algorithm on the PCA result and report your observation if the silhouette score has

    improved or not?

    c. Perform Scaling+PCA+K-Means and report performance.

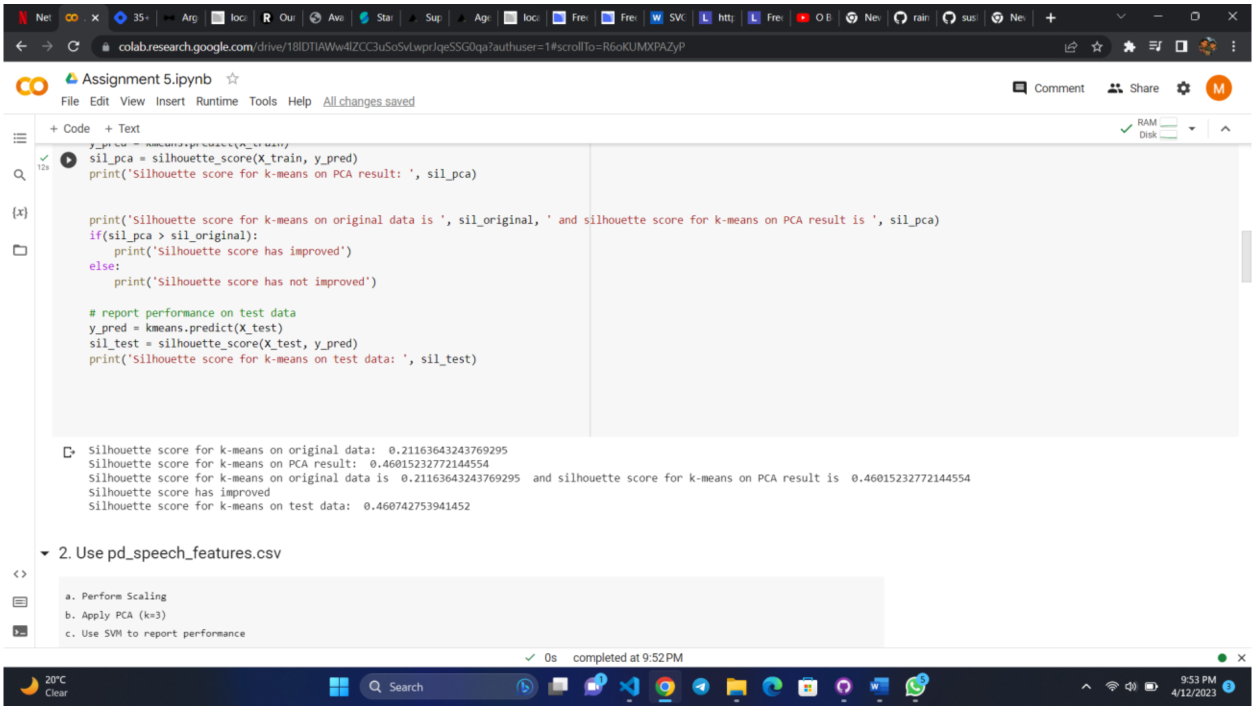
In [1]:

```
import pandas as pd

import numpy as np

from sklearn.cluster import KMeans

from sklearn.preprocessing import StandardScaler

from sklearn.decomposition import PCA

from sklearn.model_selection import train_test_split

from sklearn.metrics import silhouette_score

import warnings

warnings.filterwarnings('ignore')


# read dataset

df = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/Assignment 05/datasets/CC GENERAL.csv')

# drop CUST_ID column
```

```python
df.drop('CUST_ID', axis=1, inplace=True)
# drop rows with missing values
df.dropna(inplace=True)

# split dataset into train and test
X_train, X_test = train_test_split(df, test_size=0.2, random_state=42)

# scale fit training data
scaler = StandardScaler()
scaler.fit(X_train)

# apply transform to training and test data
X_train = scaler.transform(X_train)
X_test = scaler.transform(X_test)

# Apply k-means algorithm on the original data
kmeans = KMeans(n_clusters=2, random_state=42)
kmeans.fit(X_train)
y_pred = kmeans.predict(X_train)
sil_original = silhouette_score(X_train, y_pred)
print('Silhouette score for k-means on original data: ', sil_original)

# apply PCA to training and test data
pca = PCA(n_components=2)
pca.fit(X_train)
X_train = pca.transform(X_train)
X_test = pca.transform(X_test)

kmeans = KMeans(n_clusters=2, random_state=42)
kmeans.fit(X_train)
```

```python
y_pred = kmeans.predict(X_train)

sil_pca = silhouette_score(X_train, y_pred)

print('Silhouette score for k-means on PCA result: ', sil_pca)



print('Silhouette score for k-means on original data is ', sil_original, ' and silhouette score for k-means on PCA result is ', sil_pca)

if(sil_pca > sil_original):

    print('Silhouette score has improved')

else:

    print('Silhouette score has not improved')


# report performance on test data

y_pred = kmeans.predict(X_test)

sil_test = silhouette_score(X_test, y_pred)

print('Silhouette score for k-means on test data: ', sil_test)
```

```
Silhouette score for k-means on original data:  0.211636432437692 95
Silhouette score for k-means on PCA result:  0.46015232772144554
Silhouette score for k-means on original data is  0.21163643243769295  and silhouette score for k-means on PCA result is  0.46015232772144554
Silhouette score has improved
Silhouette score for k-means on test data:  0.460742753941452
```



2. Use pd_speech_features.csv

a. Perform Scaling

b. Apply PCA (k=3)

c. Use SVM to report performance

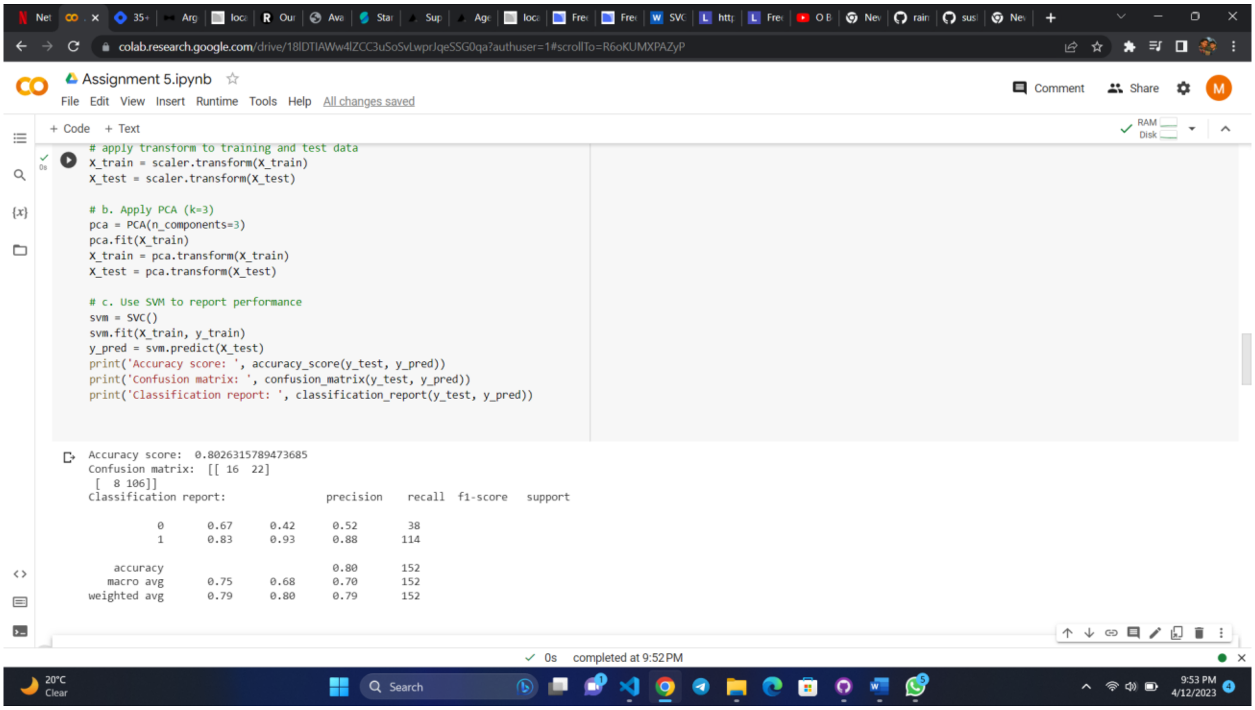
In [6]:

```
import pandas as pd
import numpy as np
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA
from sklearn.model_selection import train_test_split
from sklearn.metrics import silhouette_score
import warnings
warnings.filterwarnings('ignore')
from sklearn.svm import SVC
```

```python
from sklearn.metrics import accuracy_score
from sklearn.metrics import confusion_matrix
from sklearn.metrics import classification_report

# Use pd_speech_features.csv
df = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/Assignment 05/datasets/pd_speech_features.csv')
# drop id column
df.drop('id', axis=1, inplace=True)
# drop rows with missing values
df.dropna(inplace=True)

X = df.drop('class', axis=1)
y = df['class']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# a. Perform Scaling
scaler = StandardScaler()
scaler.fit(X_train)

# apply transform to training and test data
X_train = scaler.transform(X_train)
X_test = scaler.transform(X_test)

# b. Apply PCA (k=3)
pca = PCA(n_components=3)
pca.fit(X_train)
X_train = pca.transform(X_train)
X_test = pca.transform(X_test)
```

```python
# c. Use SVM to report performance

svm = SVC()

svm.fit(X_train, y_train)

y_pred = svm.predict(X_test)

print('Accuracy score: ', accuracy_score(y_test, y_pred))

print('Confusion matrix: ', confusion_matrix(y_test, y_pred))

print('Classification report: ', classification_report(y_test, y_pred))
```

```
Accuracy score:  0.8026315789473685
Confusion matrix:  [[ 16  22]
 [  8 106]]
Classification report:               precision    recall  f1-score   support

           0       0.67      0.42      0.52        38
           1       0.83      0.93      0.88       114

    accuracy                           0.80       152
   macro avg       0.75      0.68      0.70       152
weighted avg       0.79      0.80      0.79       152
```



3. Apply Linear Discriminant Analysis (LDA) on Iris.csv dataset to reduce dimensionality of data tok=2.

In [5]:

```
import pandas as pd
import numpy as np
# import lda
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis

# read dataset
df = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/Assignment 05/datasets/Iris.csv')
# drop id column
df.drop('Id', axis=1, inplace=True)
# drop rows with missing values
df.dropna(inplace=True)

# split dataset into train and test
X = df.drop('Species', axis=1)
```

```
y = df['Species']

# apply LDA to training and test data
lda = LinearDiscriminantAnalysis(n_components=2)
lda.fit(X, y)
X = lda.transform(X)

print(X)
```

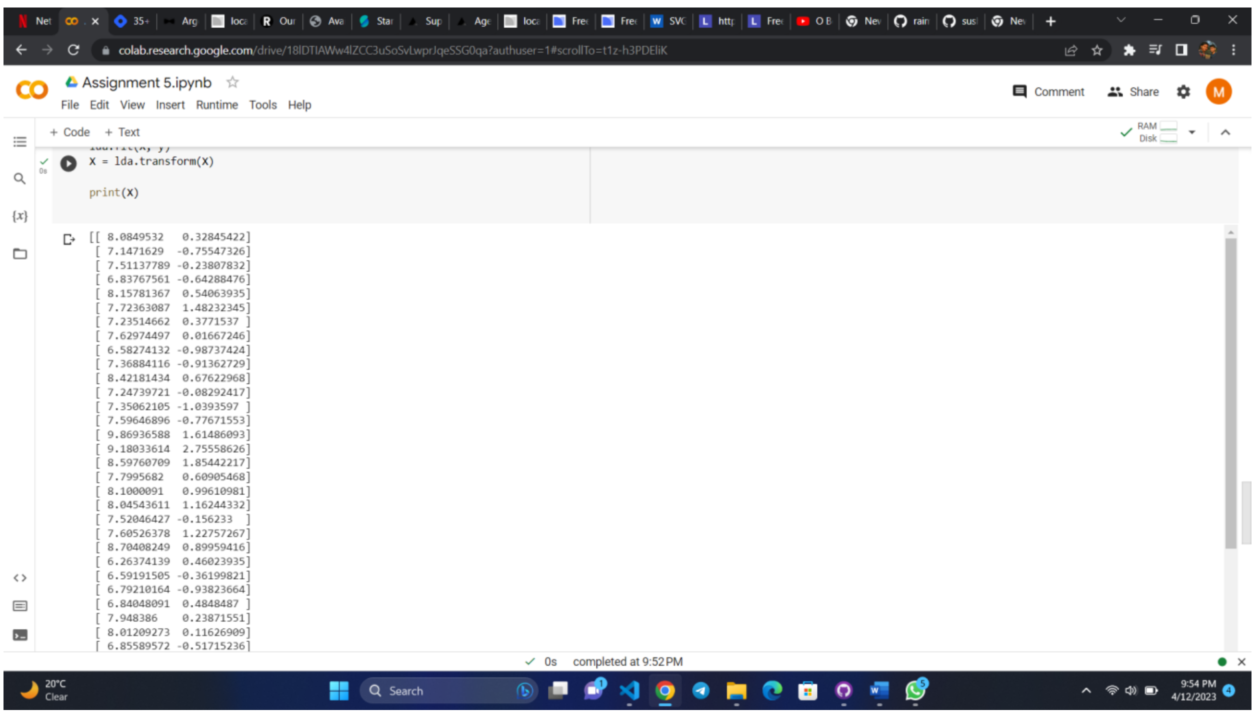
```
[[ 8.0849532   0.32845422]
 [ 7.1471629  -0.75547326]
 [ 7.51137789 -0.23807832]
 [ 6.83767561 -0.64288476]
 [ 8.15781367  0.54063935]
 [ 7.72363087  1.48232345]
 [ 7.23514662  0.3771537 ]
 [ 7.62974497  0.01667246]
 [ 6.58274132 -0.98737424]
 [ 7.36884116 -0.91362729]
 [ 8.42181434  0.67622968]
 [ 7.24739721 -0.08292417]
 [ 7.35062105 -1.0393597 ]
 [ 7.59646896 -0.77671553]
 [ 9.86936588  1.61486093]
 [ 9.18033614  2.75558626]
 [ 8.59760709  1.85442217]
 [ 7.7995682   0.60905468]
 [ 8.1000091   0.99610981]
 [ 8.04543611  1.16244332]
 [ 7.52046427 -0.156233  ]
 [ 7.60526378  1.22757267]
 [ 8.70408249  0.89959416]
 [ 6.26374139  0.46023935]
 [ 6.59191505 -0.36199821]
 [ 6.79210164 -0.93823664]
 [ 6.84048091  0.4848487 ]
 [ 7.948386    0.23871551]
 [ 8.01209273  0.11626909]
 [ 6.85589572 -0.51715236]
 [ 6.78303525 -0.72933749]
 [ 7.38668238  0.59101728]
 [ 9.16249492  1.25094169]
 [ 9.49617185  1.84989586]
```

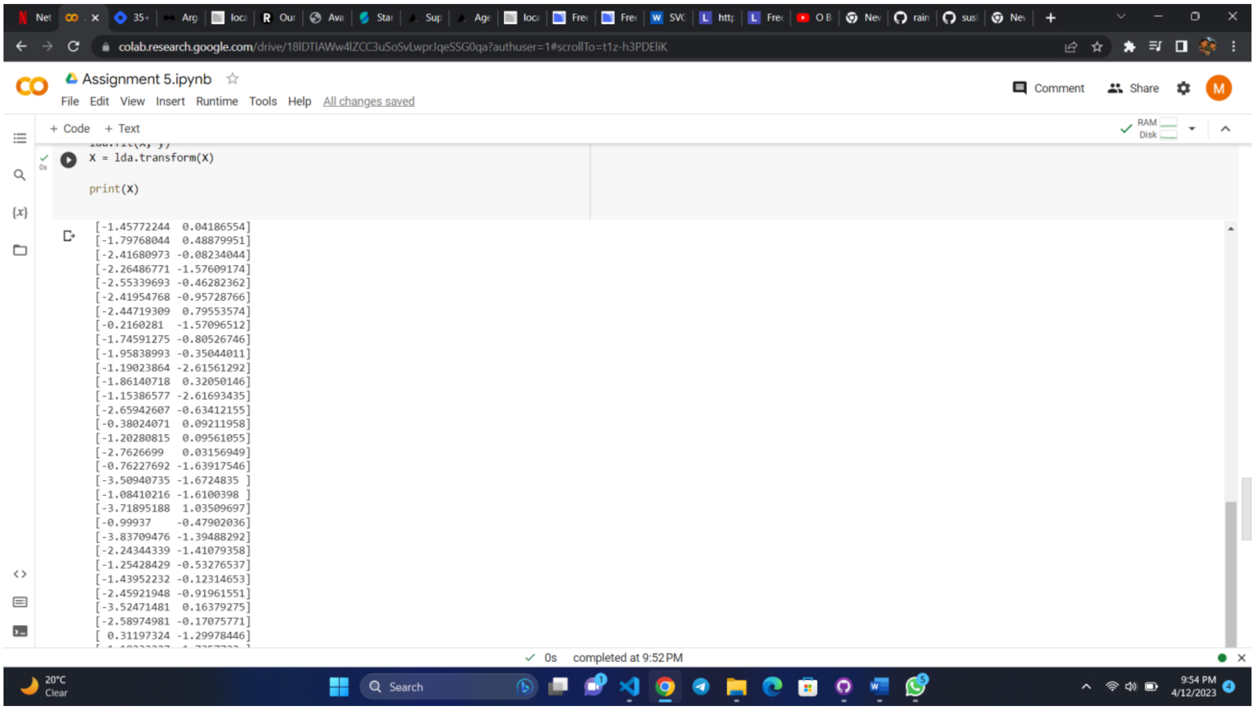
```
[ 7.36884116 -0.91362729]
[ 7.9756525  -0.13519572]
[ 8.63115466  0.4346228 ]
[ 7.36884116 -0.91362729]
[ 6.95602269 -0.67887846]
[ 7.71167183  0.01995843]
[ 7.9361354   0.69879338]
[ 5.6690533  -1.90328976]
[ 7.26559733 -0.24793625]
[ 6.42449823  1.26152073]
[ 6.88607488  1.07094506]
[ 6.77985104 -0.47815878]
[ 8.11232705  0.78881818]
[ 7.21095698 -0.33438897]
[ 8.33988749  0.6729437 ]
[ 7.69345171 -0.10577397]
[-1.45772244  0.04186554]
[-1.79768044  0.48879951]
[-2.41680973 -0.08234044]
[-2.26486771 -1.57609174]
[-2.55339693 -0.46282362]
[-2.41954768 -0.95728766]
[-2.44719309  0.79553574]
[-0.2160281  -1.57096512]
[-1.74591275 -0.80526746]
[-1.95838993 -0.35044011]
[-1.19023864 -2.61561292]
[-1.86140718  0.32050146]
[-1.15386577 -2.61693435]
[-2.65942607 -0.63412155]
[-0.38024071  0.09211958]
[-1.20280815  0.09561055]
[-2.7626699   0.03156949]
[-0.76227692 -1.63917546]
[-3.50940735 -1.6724835 ]
[-1.08410216 -1.6100398 ]
[-3.71895188  1.03509697]
[-0.99937    -0.47902036]
[-3.83709476 -1.39488292]
[-2.24344339 -1.41079358]
[-1.25428429 -0.53276537]
[-1.43952232 -0.12314653]
[-2.45921948 -0.91961551]
[-3.52471481  0.16379275]
[-2.58974981 -0.17075771]
[ 0.31197324 -1.29978446]
[-1.10232227 -1.7357722 ]
[-0.59844322 -1.92334798]
[-0.89605882 -0.89192518]
[-4.49567379 -0.87924754]
[-2.9265236   0.02499754]
```

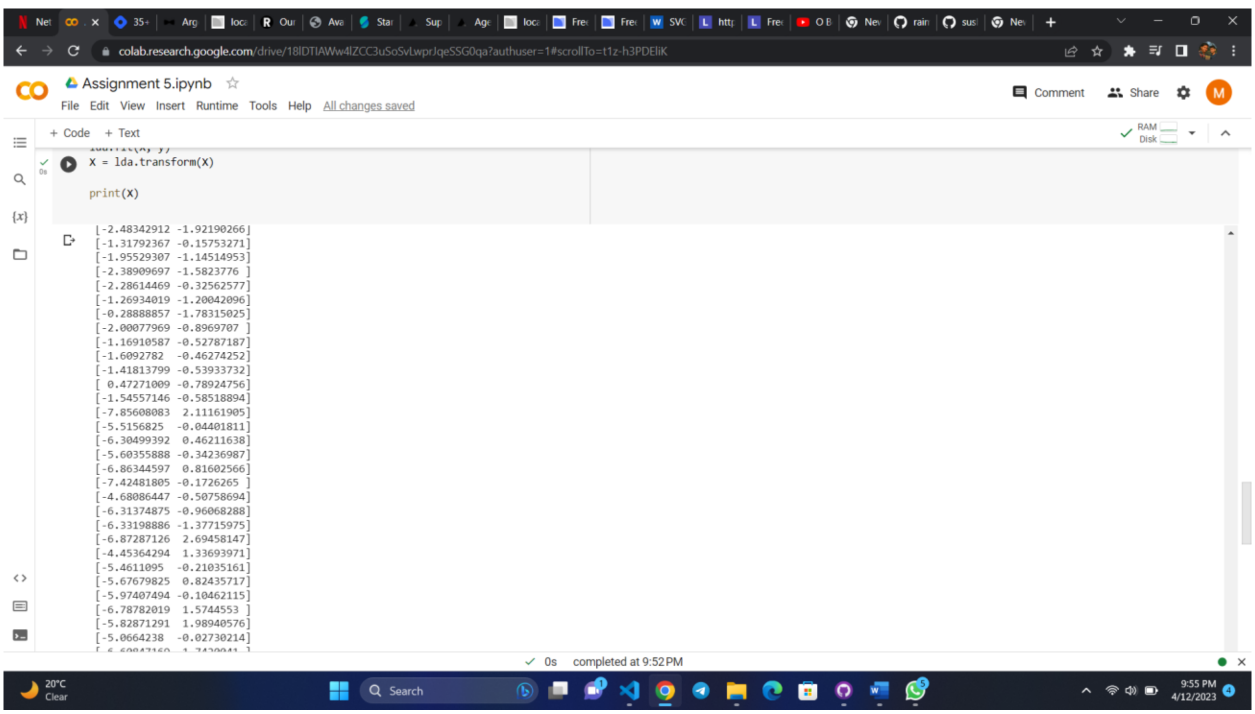
[-2.10119821 1.18719828]
[-2.14367532 0.09713697]
[-2.48342912 -1.92190266]
[-1.31792367 -0.15753271]
[-1.95529307 -1.14514953]
[-2.38909697 -1.5823776]
[-2.28614469 -0.32562577]
[-1.26934019 -1.20042096]
[-0.28888857 -1.78315025]
[-2.00077969 -0.8969707]
[-1.16910587 -0.52787187]
[-1.6092782 -0.46274252]
[-1.41813799 -0.53933732]
[0.47271009 -0.78924756]
[-1.54557146 -0.58518894]
[-7.85608083 2.11161905]
[-5.5156825 -0.04401811]
[-6.30499392 0.46211638]
[-5.60355888 -0.34236987]
[-6.86344597 0.81602566]
[-7.42481805 -0.1726265]
[-4.68086447 -0.50758694]
[-6.31374875 -0.96068288]
[-6.33198886 -1.37715975]
[-6.87287126 2.69458147]
[-4.45364294 1.33693971]
[-5.4611095 -0.21035161]
[-5.67679825 0.82435717]
[-5.97407494 -0.10462115]
[-6.78782019 1.5744553]
[-5.82871291 1.98940576]
[-5.0664238 -0.02730214]
[-6.60847169 1.7420041]
[-9.18829265 -0.74909806]
[-4.76573133 -2.14417884]
[-6.29305487 1.63373692]
[-5.37314577 0.63153087]
[-7.58557489 -0.97390788]
[-4.38367513 -0.12213933]
[-5.73135125 1.28143515]
[-5.27583147 -0.0384815]
[-4.0923206   0.18307048]
[-4.08316687 0.51770204]
[-6.53257435 0.28724638]
[-4.577648   -0.84457527]
[-6.23500611 -0.70621819]
[-5.21836582 1.46644917]
[-6.81795935 0.56784684]
[-3.80972091 -0.93451896]
[-5.09023453 -2.11775698]
[-6.82119092 0.85698379]

[-6.54193229 2.41858841]
[-4.99356333 0.18488299]
[-3.94659967 0.60744074]
[-5.22159002 1.13613893]
[-6.67858684 1.785319]
[-5.13687786 1.97641389]
[-5.5156825 -0.04401811]
[-6.81196984 1.44440158]
[-6.87289126 2.40383699]
[-5.67401294 1.66134615]
[-5.19712883 -0.36550576]
[-4.98171163 0.81297282]
[-5.90148603 2.32075134]
[-4.68400868 0.32508073]]

Outputs:







4. Briefly identify the difference between PCA and LDA

Answer - PCA is an unsupervised algorithm that is used to reduce the dimensionality of the data. It is used to find the principal components of the data. LDA is also a supervised algorithm that is used to reduce the dimensionality of the data. It is used to find the linear combination of features that characterizes or separates two or more classes.