```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
```

importing the dataset

```
dataframe=pd.read_csv("/content/drive/MyDrive/ML Data/data_banknote_authentication.txt")
dataframe.to_csv("/content/drive/MyDrive/ML Data/data_banknote_authentication.csv",index=None
dataframe.columns=['Variance','Skewness','Curtosis','Entropy','Class']
```

Analyzing the dataframe

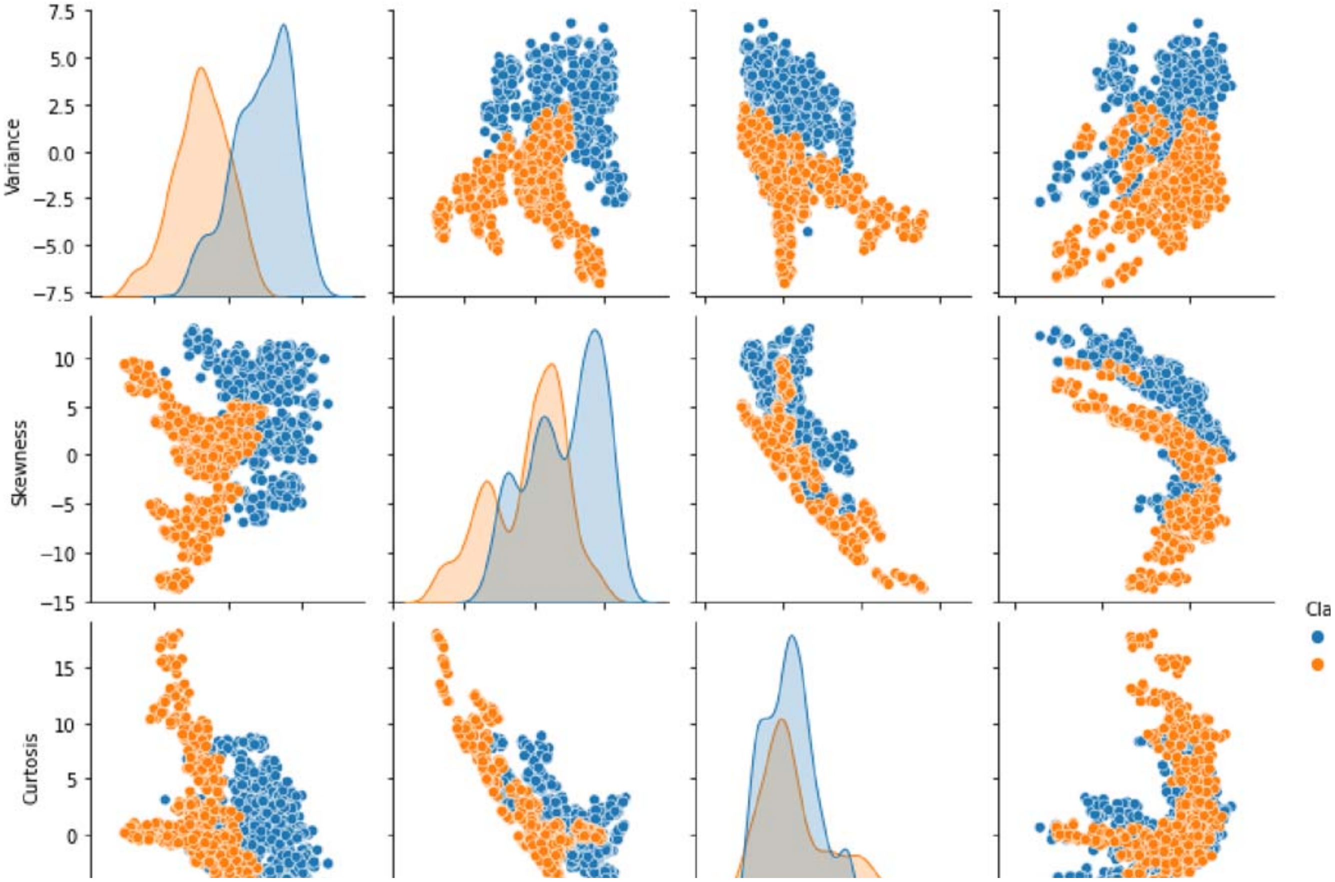
```
print(dataframe)
```

```
      Variance  Skewness  Curtosis  Entropy  Class
0      4.54590   8.16740   -2.4586 -1.46210      0
1      3.86600  -2.63830    1.9242  0.10645      0
2      3.45660   9.52280   -4.0112 -3.59440      0
3      0.32924  -4.45520    4.5718 -0.98880      0
4      4.36840   9.67180   -3.9606 -3.16250      0
...        ...       ...       ...      ...    ...
1366   0.40614   1.34920   -1.4501 -0.55949      1
1367  -1.38870  -4.87730    6.4774  0.34179      1
1368  -3.75030 -13.45860   17.5932 -2.77710      1
1369  -3.56370  -8.38270   12.3930 -1.28230      1
1370  -2.54190  -0.65804    2.6842  1.19520      1

[1371 rows x 5 columns]
```

```
sns.color_palette("tab10")
sns.pairplot(dataframe, hue="Class")
```

```
<seaborn.axisgrid.PairGrid at 0x7f2d1a188f90>
```



```
dataframe.describe()
```

	Variance	Skewness	Curtosis	Entropy	Class
count	1371.000000	1371.000000	1371.000000	1371.000000	1371.000000
mean	0.431410	1.917434	1.400694	-1.192200	0.444931
std	2.842494	5.868359	4.310105	2.101683	0.497139
min	-7.042100	-13.773100	-5.286100	-8.548200	0.000000
25%	-1.774700	-1.711300	-1.553350	-2.417000	0.000000
50%	0.495710	2.313400	0.616630	-0.586650	0.000000
75%	2.814650	6.813100	3.181600	0.394810	1.000000
max	6.824800	12.951600	17.927400	2.449500	1.000000

```
attributes=dataframe.iloc[:,:-1].values
labels=dataframe.iloc[:,-1].values
```

```
print(labels.shape)
```

```
(1371,)
```

```
print(attributes)
print(attributes)
print(labels)
```

```
[[  4.5459    8.1674   -2.4586   -1.4621 ]
 [  3.866    -2.6383    1.9242    0.10645]
 [  3.4566    9.5228   -4.0112   -3.5944 ]
 ...
 [ -3.7503  -13.4586   17.5932   -2.7771 ]
 [ -3.5637   -8.3827   12.393    -1.2823 ]
 [ -2.5419   -0.65804   2.6842    1.1952 ]]
[0 0 0 ... 1 1 1]
```

```
Ylabel0=[]
Ylabel1=[]
for index, label in enumerate(labels):
  if label==0:
    Ylabel0.append(index)
  if label==1:
    Ylabel1.append(index)


x1=np.delete(attributes,Ylabel0,axis=0)
y1=np.delete(labels,Ylabel0,axis=0)

x0=np.delete(attributes,Ylabel1,axis=0)
y0=np.delete(labels,Ylabel1,axis=0)
```

Train Test split of data

```
from sklearn.model_selection import train_test_split

x1_train,x1_test,y1_train,y1_test=train_test_split(x1,y1,test_size=0.5,random_state=6)
x0_train,x0_test,y0_train,y0_test=train_test_split(x0,y0,test_size=0.5,random_state=6)

x_train=np.concatenate((x1_train,x0_train),axis=0)
y_train=np.concatenate((y1_train,y0_train),axis=0)
x_test=np.concatenate((x1_test,x0_test),axis=0)
y_test=np.concatenate((y1_test,y0_test),axis=0)
```

Prediction

```
from sklearn.naive_bayes import GaussianNB
Classifier=GaussianNB()
Classifier.fit(x_train,y_train)
predicted=Classifier.predict(x_test)
```

Analysis of predicted results

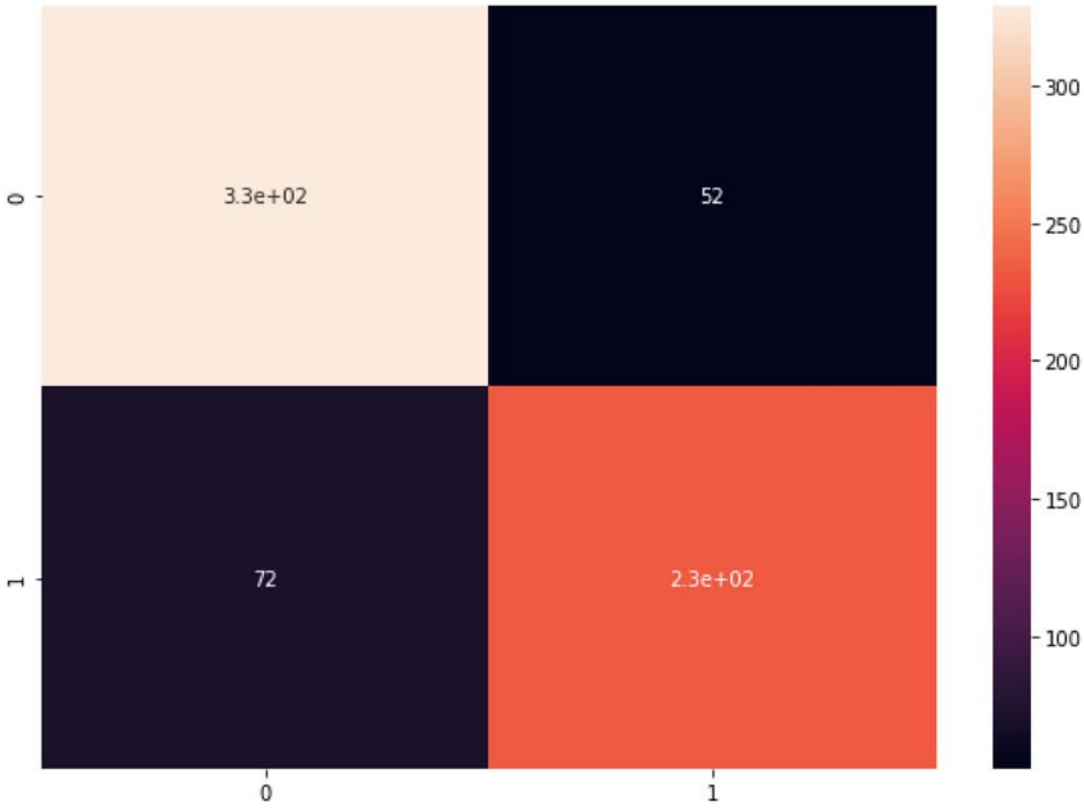
```
from sklearn.metrics import confusion_matrix,classification_report,accuracy_score
print("Confusion Matrix:")
print(confusion_matrix(y_test, predicted))


import pandas as pd

array = confusion_matrix(y_test, predicted)
df_cm = pd.DataFrame(array, index = [i for i in "01"],
                  columns = [i for i in "01"])
plt.figure(figsize = (10,7))
sns.heatmap(df_cm, annot=True)

plt.show()
```

```
Confusion Matrix:
[[329  52]
 [ 72 233]]
```



```
print(classification_report(y_test, predicted))
print(accuracy_score(y_test, predicted))
```

```
              precision    recall  f1-score   support

           0       0.82      0.86      0.84       381
           1       0.82      0.76      0.79       305

    accuracy                           0.82       686
   macro avg       0.82      0.81      0.82       686
weighted avg       0.82      0.82      0.82       686
```

```
0.8192419825072886
```

```
from sklearn.metrics import roc_curve,auc
import plotly.express as px

fpr, tpr, thresholds = roc_curve(predicted, y_test)

from sklearn.metrics import confusion_matrix

figCurve = px.area(
    x=fpr, y=tpr,
    title=f'ROC Curve (AUC={auc(fpr, tpr):.3f})',
    labels=dict(x='False Positive Rate', y='True Positive Rate'),
    color=["blue","red","green"]
)
figCurve.add_shape(
    type='line', line=dict(dash='dash'),
    x0=0, x1=1, y0=0, y1=1
)

figCurve.update_yaxes(scaleanchor="x", scaleratio=1)
figCurve.update_xaxes(constrain='domain')

figCurve.show()
```

ROC Curve (AUC=0.819)

```
Classifier.class_prior_=[0.1,0.9]
y1_pred=Classifier.predict(x_test)
```

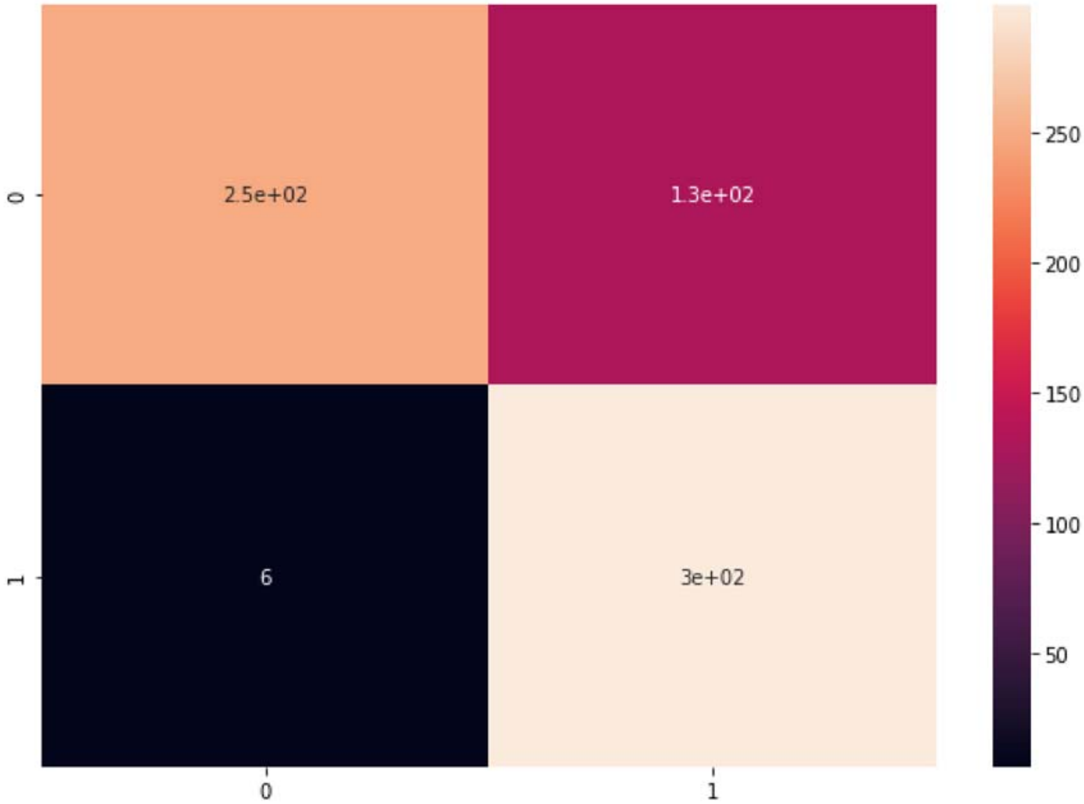
```
from sklearn.metrics import confusion_matrix,classification_report,accuracy_score
print("Confusion Matrix:")
print(confusion_matrix(y_test, y1_pred))

import pandas as pd

array = confusion_matrix(y_test, y1_pred)
df_cm = pd.DataFrame(array, index = [i for i in "01"],
                  columns = [i for i in "01"])
plt.figure(figsize = (10,7))
sns.heatmap(df_cm, annot=True)

plt.show()
```

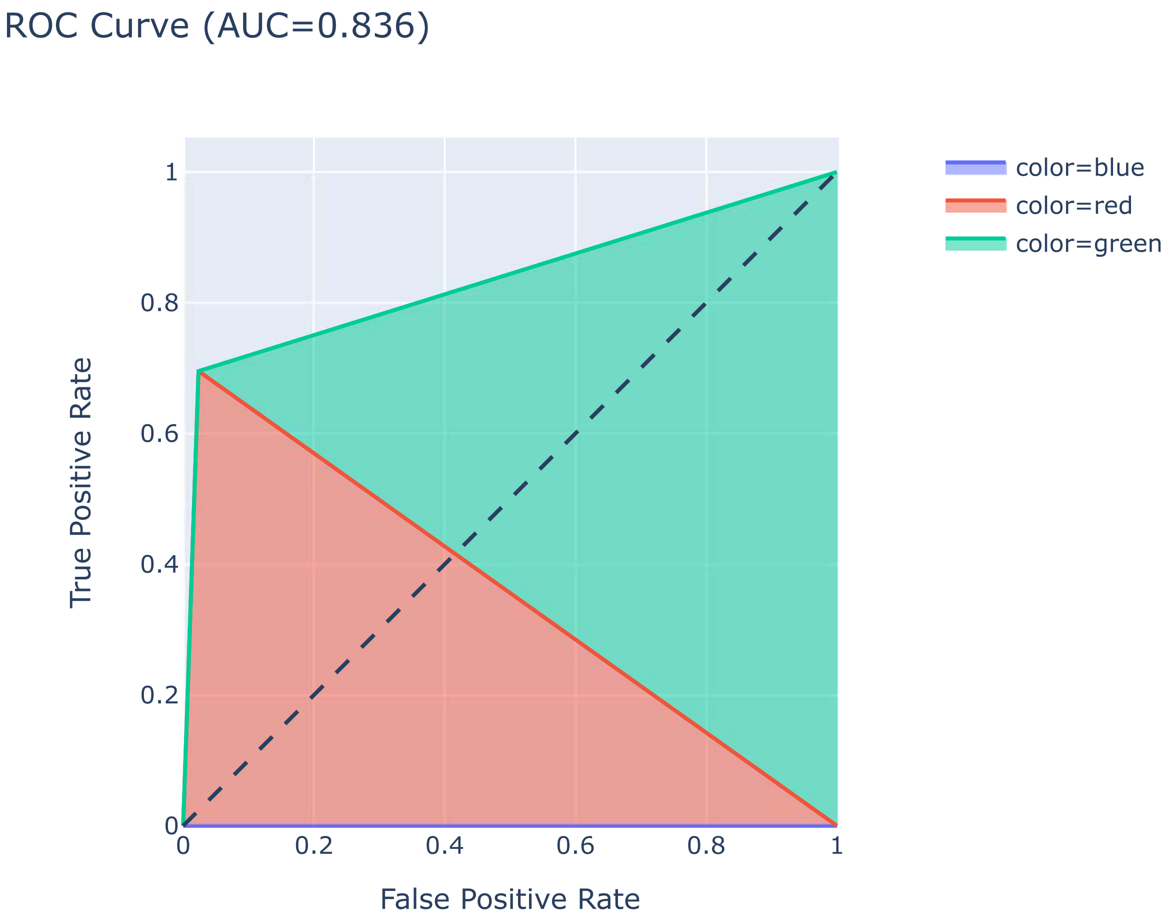
```
Confusion Matrix:
[[250 131]
 [  6 299]]
```



```
fpr1, tpr1, thresholds1 = roc_curve(y1_pred, y_test)
figCurve1 = px.area(
    x=fpr1, y=tpr1,
    x=fpr1, y=tpr1,
    title=f'ROC Curve (AUC={auc(fpr1, tpr1):.3f})',
    labels=dict(x='False Positive Rate', y='True Positive Rate'),
    color=["blue","red","green"]
)
figCurve1.add_shape(
    type='line', line=dict(dash='dash'),
    x0=0, x1=1, y0=0, y1=1
)

figCurve1.update_yaxes(scaleanchor="x", scaleratio=1)
figCurve1.update_xaxes(constrain='domain')

figCurve1.show()
```


ROC Curve (AUC=0.836)
True Positive Rate
False Positive Rate
color=blue
color=red
color=green