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DMW

Exp3

Aim: Implementation of Classification algorithm Using

1. Decision Tree ID3 and 2. Naïve Bayes algorithm Perform

the experiment in Python.

Read any dataset from UCI dataset repository

Theory:

Decision tree ID3:

In simple words, a decision tree is a structure that contains nodes (rectangular boxes) and edges(arrows) and is built from a dataset (table of columns representing features/attributes and rows corresponds to records). Each node is either used to make a decision (known as decision node) or represent an outcome (known as leaf node).ID3 stands for Iterative Dichotomiser 3 and is named such because the algorithm iteratively (repeatedly) dichotomizes(divides) features into two or more groups at each step.ID3 uses a top-down greedy approach to build a decision tree. In simple words, the top-down approach means that we start building the tree from the top and the greedy approach means that at each iteration we select the best feature at the present moment to create a node.

Naive Bayes:

Naive Bayes classifiers are a collection of classification algorithms based on Bayes' Theorem. It is not a single algorithm but a family of algorithms where all of them share a common principle, i.e. every pair of features being classified is independent of each other.

To start with, let us consider a dataset.

Consider a fictional dataset that describes the weather conditions for playing a game of golf. Given the weather conditions, each tuple classifies the conditions as fit("Yes") or unfit("No") for playing golf.

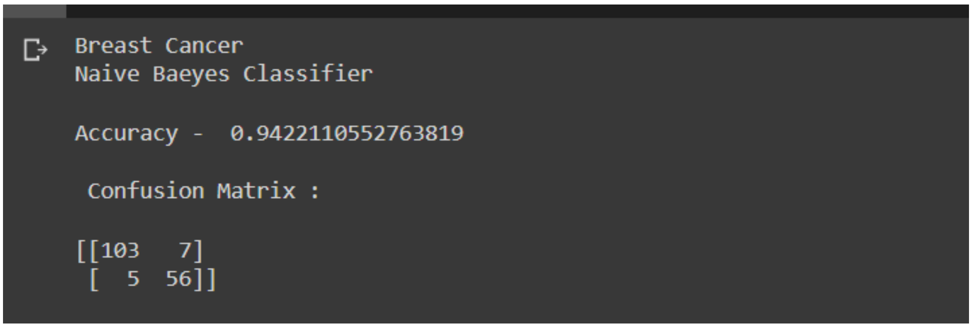
Dataset – 1 :

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import confusion_matrix, roc_curve, roc_auc_score, accuracy_score, classification_report
import matplotlib.pyplot as plt
from sklearn import tree
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import cross_val_score
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import LabelEncoder
import seaborn as sns

#Dataframe creation
df = pd.read_csv("/content/data.csv")
df = df.dropna()

# Train test split
y = df.diagnosis
x = df.drop(['diagnosis','id'],axis=1)

X_train, X_val, Y_train, Y_val = train_test_split(x, y, test_size = 0.3, random_state=255)

# Gaussian model
gnb = GaussianNB()
gnb.fit(X_train, Y_train)

y_val_pred = gnb.predict(X_val)
y_train_pred = gnb.predict(X_train)
nb_cancer = gnb.score(X_train, Y_train)*100

# Prediction and Confusion Matrix
print("Breast Cancer ")
print("Naive Baeyes Classifier")
print(f"\nAccuracy - ", gnb.score(X_train, Y_train))
print(f"\n Confusion Matrix : \n")
con_matrix = confusion_matrix(Y_val,y_val_pred)
print(con_matrix)

#Plotting of AUCROC
y_score = gnb.predict_proba(X_val)[ :,1]
```

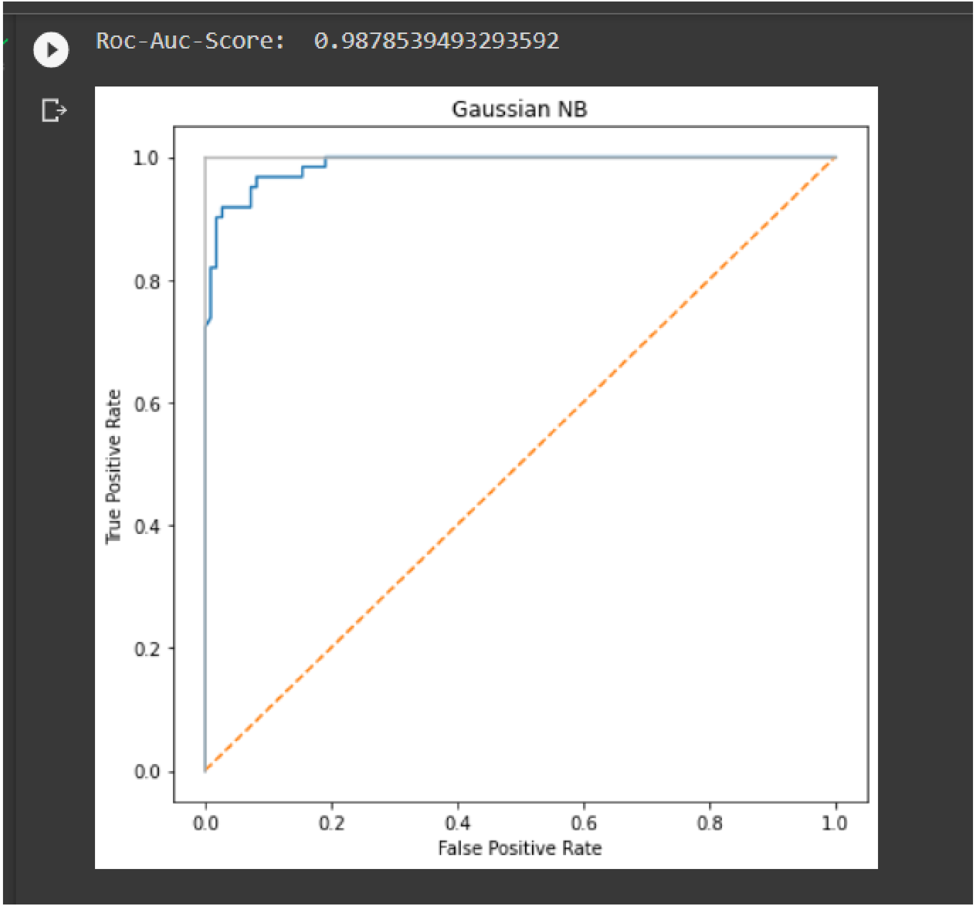
```python
false_positive, true_positive, threshold = roc_curve(Y_val, y_score)
print("\nRoc-Auc-Score: ", roc_auc_score(Y_val, y_score))
print()

plt.subplots(1, figsize = (7, 7))
plt.title("Gaussian NB")
plt.plot(false_positive, true_positive)
plt.plot([0, 1], ls = "--")
plt.plot([0,0], [1,0], c="0.7"), plt.plot([1,1], c="0.7")
plt.ylabel("True Positive Rate")
plt.xlabel("False Positive Rate")
plt.show()

dt = DecisionTreeClassifier()
dt.fit(X_train, Y_train)

y_val_pred = dt.predict(X_val)
dt_cancer = dt.score(X_val, Y_val)*100

#Prediction and Confusion Matrix
print("\n\nDecission Tree")
print(f"\nAccuracy - ", dt.score(X_val, Y_val))
print(f"\n Confusion Matrix : ")
print("\n", confusion_matrix(Y_val, y_val_pred))

#Plotting of AUCROC
y_score = dt.predict_proba(X_val)[ :,1]

false_positive, true_positive, threshold = roc_curve(Y_val, y_score)
print("\nRoc-Auc-Score: ", roc_auc_score(Y_val, y_score))
print()

plt.subplots(1, figsize = (7, 7))
plt.title("Gaussian NB")
plt.plot(false_positive, true_positive)
plt.plot([0, 1], ls = "--")
plt.plot([0,0], [1,0], c="0.7"), plt.plot([1,1], c="0.7")
plt.ylabel("True Positive Rate")
plt.xlabel("False Positive Rate")
plt.show()

# Kfolds cross validation
pipeline = make_pipeline(StandardScaler(), RandomForestClassifier(n_estimators=100, max_depth=4))
X = X_train
y = Y_train
scores = cross_val_score(pipeline, X, y, cv=10, n_jobs=1)
print('Cross Validation accuracy scores: %s' % scores)

# Random Forest Classifier
m = RandomForestClassifier()
```

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3)
# print(X_train.head(), X_test.head(), y_train.head(), y_test.head())
m.fit(X_train, y_train)
print(f"\nAccuracy of Random forest classifier is {m.score(X_test, y_test)}"
)
```

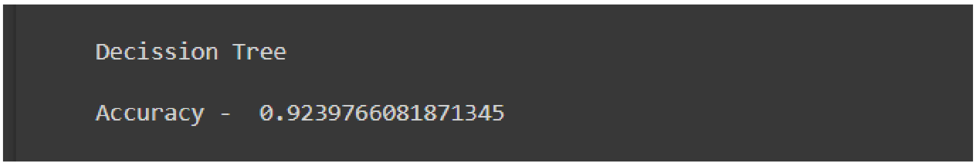
Output :-



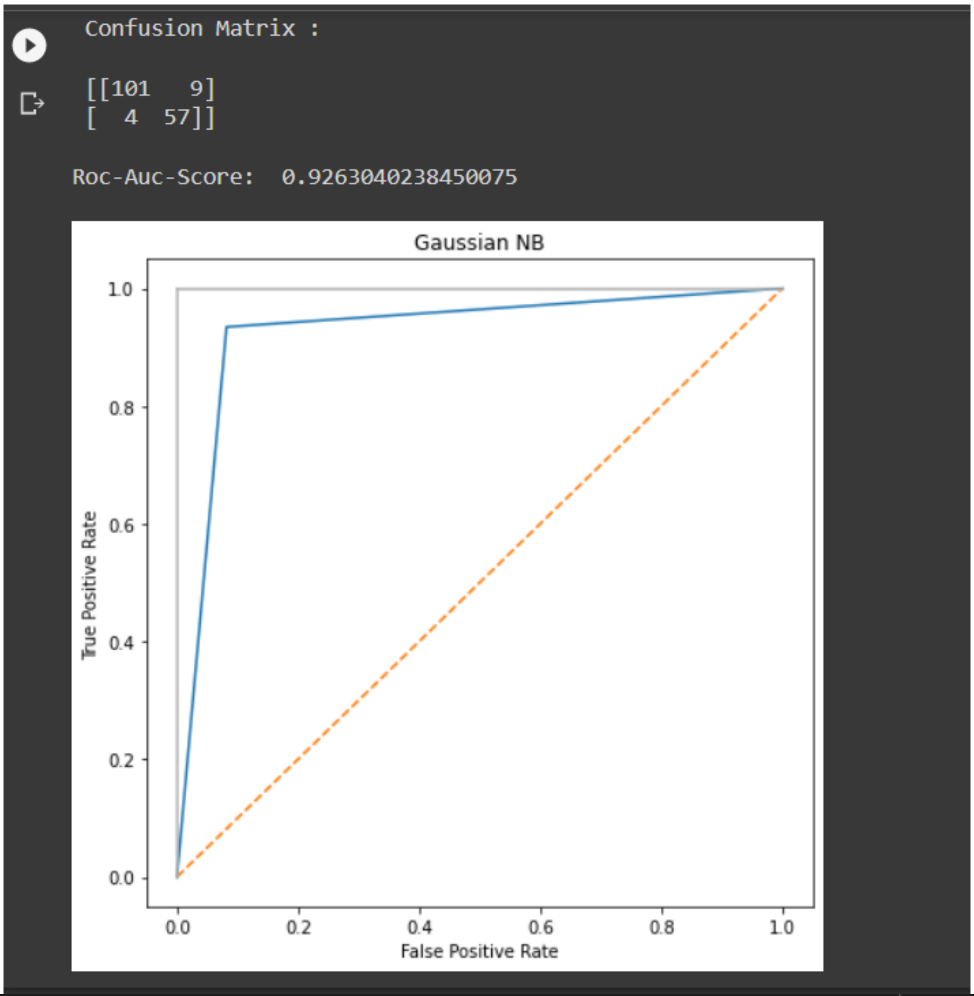
```
Breast Cancer
Naive Baeyes Classifier

Accuracy -  0.9422110552763819

 Confusion Matrix :

[[103   7]
 [  5  56]]
```



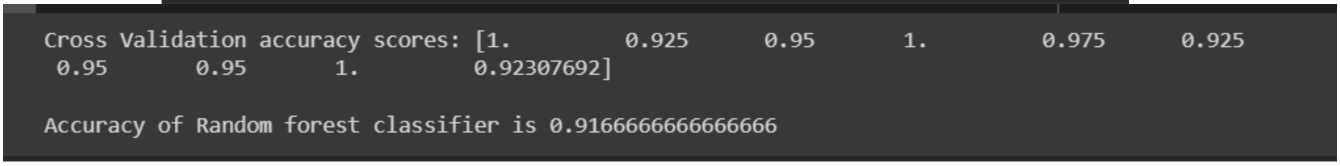
```
Roc-Auc-Score:  0.9878539493293592
```



```
Decission Tree

Accuracy -  0.9239766081871345
```



```
Confusion Matrix :

[[101   9]
 [  4  57]]

Roc-Auc-Score:  0.9263040238450075
```



```
Cross Validation accuracy scores: [1.         0.925      0.95       1.         0.975      0.925
 0.95       0.95       1.         0.92307692]

Accuracy of Random forest classifier is 0.9166666666666666
```

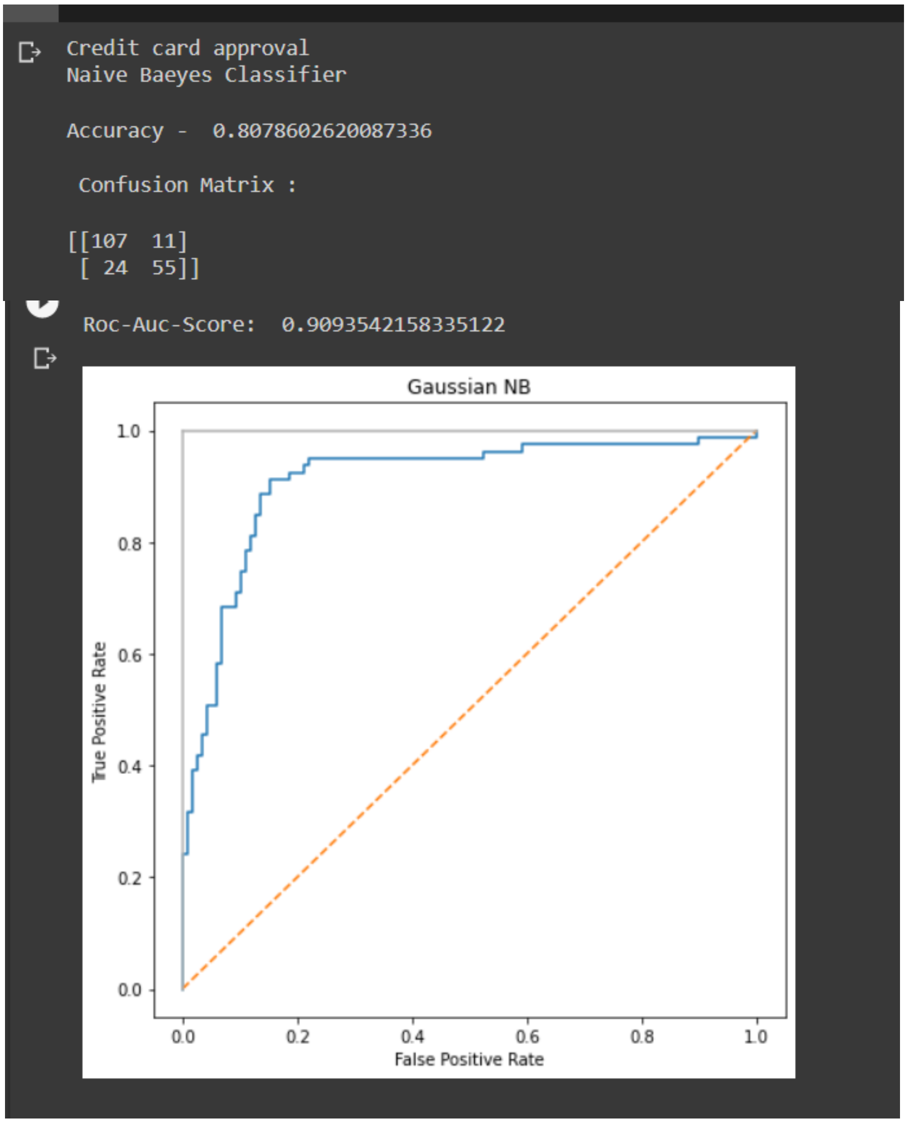
Dataset – 2 :

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import confusion_matrix, roc_curve, roc_auc_score, accu
racy_score, classification_report
import matplotlib.pyplot as plt
from sklearn import tree
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import cross_val_score
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import LabelEncoder
import seaborn as sns

#Dataframe creation
df = pd.read_csv("/content/clean_dataset.csv")
df = df.dropna()

# Train test split
y = df.Approved
x = df.drop(['Approved'],axis=1)

X_train, X_val, Y_train, Y_val = train_test_split(x, y, test_size = 0.3, ran
dom_state=255)

# Gaussian model
gnb = GaussianNB()
gnb.fit(X_train, Y_train)

y_val_pred = gnb.predict(X_val)
y_train_pred = gnb.predict(X_train)
nb_credit = gnb.score(X_train, Y_train)*100

# Prediction and Confusion Matrix
print("Credit card approval ")
print("Naive Baeyes Classifier")
print(f"\nAccuracy - ", gnb.score(X_train, Y_train))
print(f"\n Confusion Matrix : \n")
con_matrix = confusion_matrix(Y_val,y_val_pred)
print(con_matrix)

#Plotting of AUCROC
y_score = gnb.predict_proba(X_val)[ :,1]

false_positive, true_positive, threshold = roc_curve(Y_val, y_score)
```

```
print("\nRoc-Auc-Score: ", roc_auc_score(Y_val, y_score))
print()

plt.subplots(1, figsize = (7, 7))
plt.title("Gaussian NB")
plt.plot(false_positive, true_positive)
plt.plot([0, 1], ls = "--")
plt.plot([0,0], [1,0], c="0.7"), plt.plot([1,1], c="0.7")
plt.ylabel("True Positive Rate")
plt.xlabel("False Positive Rate")
plt.show()

dt = DecisionTreeClassifier()
dt.fit(X_train, Y_train)

y_val_pred = dt.predict(X_val)
dt_credit = dt.score(X_val, Y_val)*100

#Prediction and Confusion Matrix
print("\n\nDecission Tree")
print(f"\nAccuracy - ", dt.score(X_val, Y_val))
print(f"\n Confusion Matrix : ")
print("\n", confusion_matrix(Y_val, y_val_pred))

#Plotting of AUCROC
y_score = dt.predict_proba(X_val)[ :,1]

false_positive, true_positive, threshold = roc_curve(Y_val, y_score)
print("\nRoc-Auc-Score: ", roc_auc_score(Y_val, y_score))
print()

plt.subplots(1, figsize = (7, 7))
plt.title("Gaussian NB")
plt.plot(false_positive, true_positive)
plt.plot([0, 1], ls = "--")
plt.plot([0,0], [1,0], c="0.7"), plt.plot([1,1], c="0.7")
plt.ylabel("True Positive Rate")
plt.xlabel("False Positive Rate")
plt.show()

# Kfolds cross validation
pipeline = make_pipeline(StandardScaler(), RandomForestClassifier(n_estimators=100, max_depth=4))
X = X_train
y = Y_train
scores = cross_val_score(pipeline, X, y, cv=10, n_jobs=1)
print('\n\nCross Validation accuracy scores: %s' % scores)

# Random Forest Classifier
m = RandomForestClassifier()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3)
```

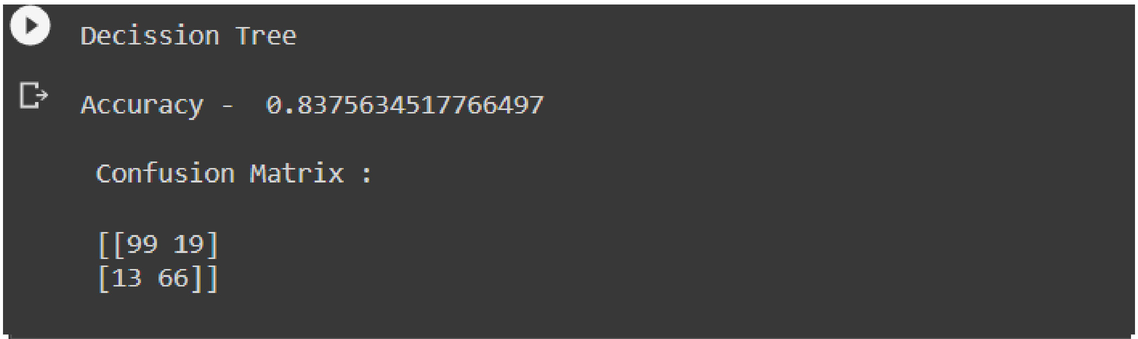
```
# print(X_train.head(), X_test.head(), y_train.head(), y_test.head())
m.fit(X_train, y_train)
print(f"\nAccuracy of Random forest classifier is {m.score(X_test, y_test)}"
)
```

Output :-

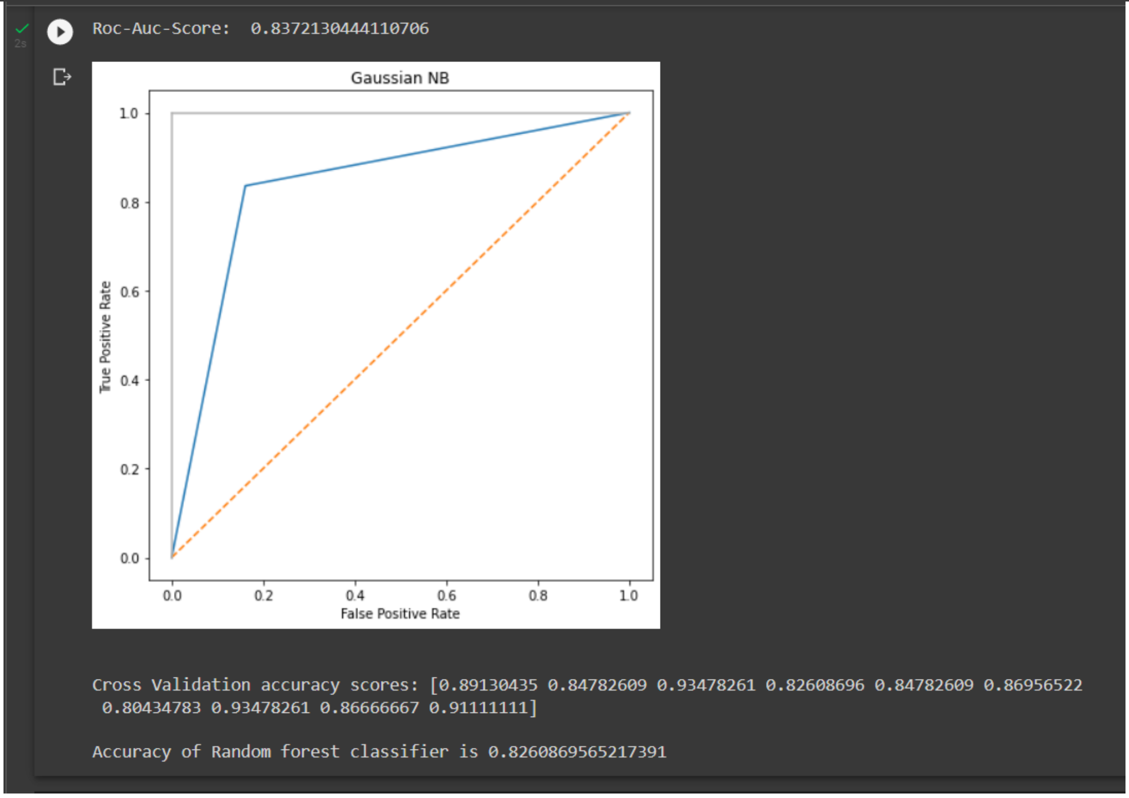


```
Credit card approval
Naive Baeyes Classifier

Accuracy -  0.8078602620087336

 Confusion Matrix :

[[107  11]
 [ 24  55]]
```

```
Roc-Auc-Score:  0.9093542158335122
```



```
Decission Tree

Accuracy -  0.8375634517766497

 Confusion Matrix :

 [[99 19]
 [13 66]]
```



```
Roc-Auc-Score:  0.8372130444110706
```

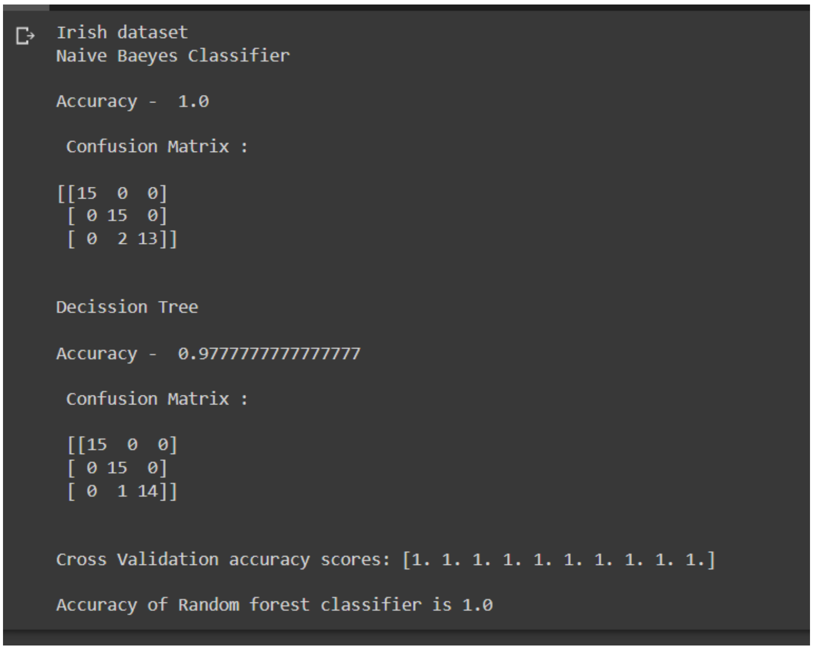
```
Cross Validation accuracy scores: [0.89130435 0.84782609 0.93478261 0.82608696 0.84782609 0.86956522
 0.80434783 0.93478261 0.86666667 0.91111111]

Accuracy of Random forest classifier is 0.8260869565217391
```

Dataset – 3 :

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import confusion_matrix, roc_curve, roc_auc_score, accuracy_score, classification_report
import matplotlib.pyplot as plt
from sklearn import tree
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import cross_val_score
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import LabelEncoder
import seaborn as sns

#Dataframe creation
df = pd.read_csv("/content/Iris (1).csv")
df = df.dropna()

# Train test split
y = df.Species
x = df.drop(['Species'],axis=1)

X_train, X_val, Y_train, Y_val = train_test_split(x, y, test_size = 0.3, random_state=255)

# Gaussian model
gnb = GaussianNB()
gnb.fit(X_train, Y_train)

y_val_pred = gnb.predict(X_val)
y_train_pred = gnb.predict(X_train)
nb_iris = gnb.score(X_train, Y_train)*100

# Prediction and Confusion Matrix
print("Audit risk  ")
print("Naive Baeyes Classifier")
print(f"\nAccuracy - ", gnb.score(X_train, Y_train))
print(f"\n Confusion Matrix : \n")
con_matrix = confusion_matrix(Y_val,y_val_pred)
print(con_matrix)

# Decision Tree
dt = DecisionTreeClassifier()
dt.fit(X_train, Y_train)
```

```
y_val_pred = dt.predict(X_val)
dt_iris = dt.score(X_val, Y_val)*100

#Prediction and Confusion Matrix
print("\n\nDecission Tree")
print(f"\nAccuracy - ", dt.score(X_val, Y_val))
print(f"\n Confusion Matrix : ")
print("\n", confusion_matrix(Y_val, y_val_pred))

# Kfolds cross validation
pipeline = make_pipeline(StandardScaler(), RandomForestClassifier(n_estimato
rs=100, max_depth=4))
X = X_train
y = Y_train
scores = cross_val_score(pipeline, X, y, cv=10, n_jobs=1)
print('\n\nCross Validation accuracy scores: %s' % scores)

# Random Forest Classifier
m = RandomForestClassifier()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3)
# print(X_train.head(), X_test.head(), y_train.head(), y_test.head())
m.fit(X_train, y_train)
print(f"\nAccuracy of Random forest classifier is {m.score(X_test, y_test)}"
)
```

Output :-

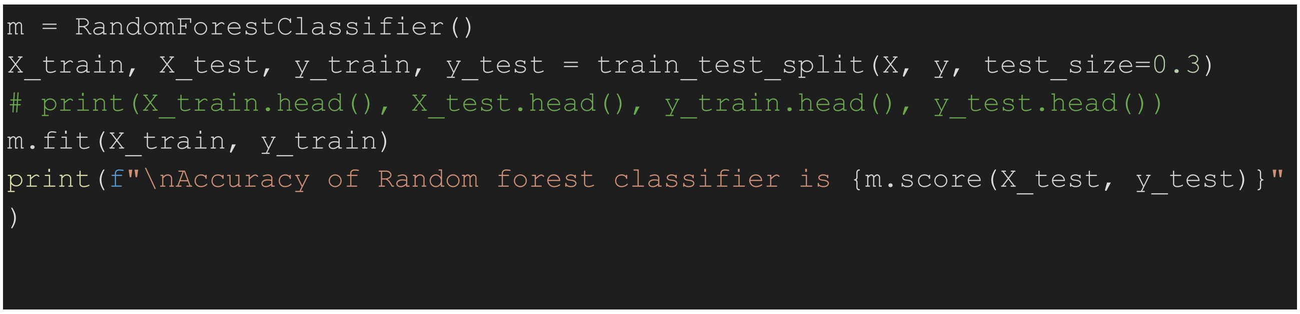


```
Irish dataset
Naive Baeyes Classifier

Accuracy -  1.0

 Confusion Matrix :

[[15  0  0]
 [ 0 15  0]
 [ 0  2 13]]


Decission Tree

Accuracy -  0.9777777777777777

 Confusion Matrix :

 [[15  0  0]
 [ 0 15  0]
 [ 0  1 14]]


Cross Validation accuracy scores: [1. 1. 1. 1. 1. 1. 1. 1. 1. 1.]

Accuracy of Random forest classifier is 1.0
```

Dataset – 4 :

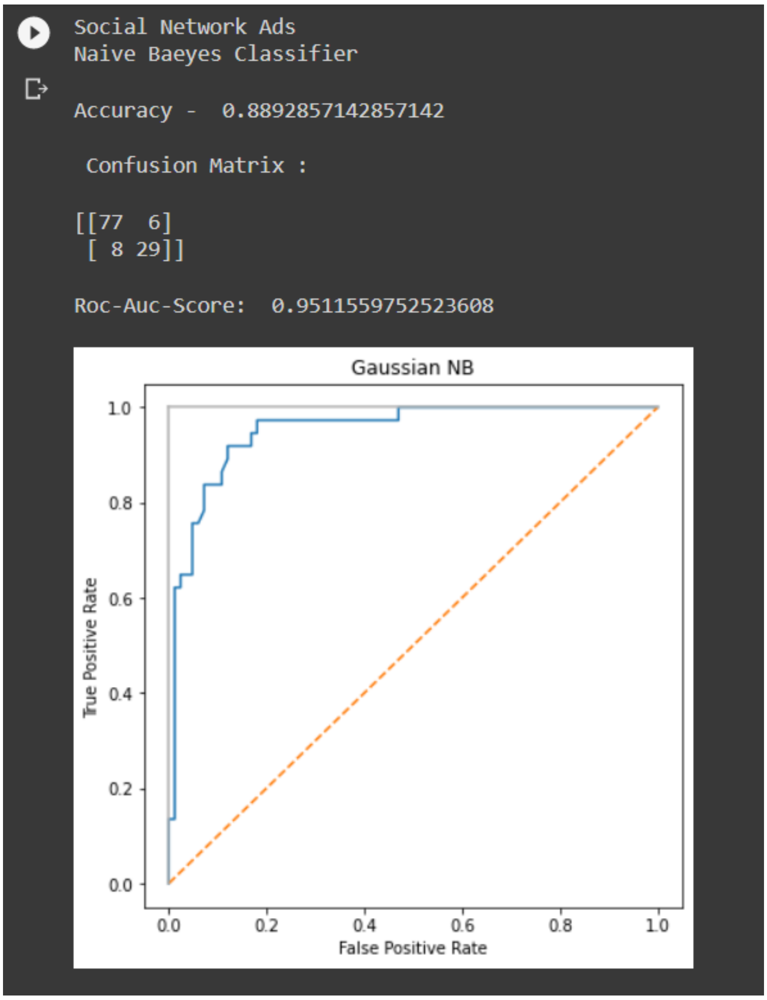
```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import confusion_matrix, roc_curve, roc_auc_score, accu
racy_score, classification_report
import matplotlib.pyplot as plt
from sklearn import tree
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import cross_val_score
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import LabelEncoder
import seaborn as sns

#Dataframe creation
df = pd.read_csv("/content/Social_Network_Ads.csv")
df = df.dropna()

# Train test split
y = df.Purchased
x = df.drop(['Purchased'],axis=1)

X_train, X_val, Y_train, Y_val = train_test_split(x, y, test_size = 0.3, ran
dom_state=255)

# Gaussian model
gnb = GaussianNB()
gnb.fit(X_train, Y_train)

y_val_pred = gnb.predict(X_val)
y_train_pred = gnb.predict(X_train)
nb_social = gnb.score(X_train, Y_train)*100

# Prediction and Confusion Matrix
print("Social Network Ads ")
print("Naive Baeyes Classifier")
print(f"\nAccuracy - ", gnb.score(X_train, Y_train))
print(f"\n Confusion Matrix : \n")
con_matrix = confusion_matrix(Y_val,y_val_pred)
print(con_matrix)

#Plotting of AUCROC
y_score = gnb.predict_proba(X_val)[ :,1]
```

```
false_positive, true_positive, threshold = roc_curve(Y_val, y_score)
print("\nRoc-Auc-Score: ", roc_auc_score(Y_val, y_score))
print()

plt.subplots(1, figsize = (6, 6))
plt.title("Gaussian NB")
plt.plot(false_positive, true_positive)
plt.plot([0, 1], ls = "--")
plt.plot([0,0], [1,0], c="0.7"), plt.plot([1,1], c="0.7")
plt.ylabel("True Positive Rate")
plt.xlabel("False Positive Rate")
plt.show()

dt = DecisionTreeClassifier()
dt.fit(X_train, Y_train)

y_val_pred = dt.predict(X_val)
dt_social = dt.score(X_val, Y_val)*100

#Prediction and Confusion Matrix
print("\n\nDecission Tree")
print(f"\nAccuracy - ", dt.score(X_val, Y_val))
print(f"\n Confusion Matrix : ")
print("\n", confusion_matrix(Y_val, y_val_pred))


#Plotting of AUCROC
y_score = dt.predict_proba(X_val)[ :,1]

false_positive, true_positive, threshold = roc_curve(Y_val, y_score)
print("\nRoc-Auc-Score: ", roc_auc_score(Y_val, y_score))
print()

plt.subplots(1, figsize = (6, 6))
plt.title("Gaussian NB")
plt.plot(false_positive, true_positive)
plt.plot([0, 1], ls = "--")
plt.plot([0,0], [1,0], c="0.7"), plt.plot([1,1], c="0.7")
plt.ylabel("True Positive Rate")
plt.xlabel("False Positive Rate")
plt.show()

# Kfolds cross validation
pipeline = make_pipeline(StandardScaler(), RandomForestClassifier(n_estimators=100, max_depth=4))
X = X_train
y = Y_train
scores = cross_val_score(pipeline, X, y, cv=10, n_jobs=1)
print('\n\nCross Validation accuracy scores: %s' % scores)

# Random Forest Classifier
```

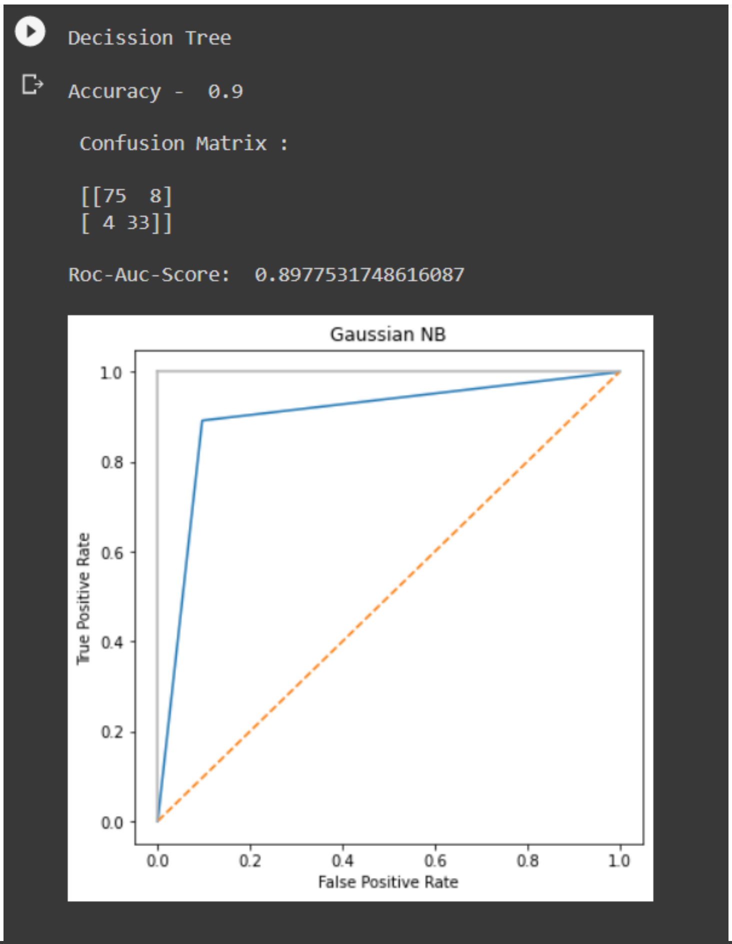


```
m = RandomForestClassifier()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3)
# print(X_train.head(), X_test.head(), y_train.head(), y_test.head())
m.fit(X_train, y_train)
print(f"\nAccuracy of Random forest classifier is {m.score(X_test, y_test)}"
)
```

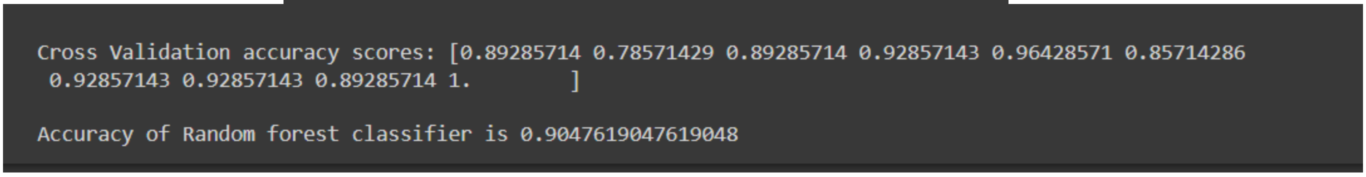
Output :-



```
Social Network Ads
Naive Baeyes Classifier

Accuracy -  0.8892857142857142

 Confusion Matrix :

[[77  6]
 [ 8 29]]

Roc-Auc-Score:  0.9511559752523608
```



```
Decission Tree

Accuracy -  0.9

 Confusion Matrix :

 [[75  8]
 [ 4 33]]

Roc-Auc-Score:  0.8977531748616087
```



```
Cross Validation accuracy scores: [0.89285714 0.78571429 0.89285714 0.92857143 0.96428571 0.85714286
 0.92857143 0.92857143 0.89285714 1.        ]

Accuracy of Random forest classifier is 0.9047619047619048
```

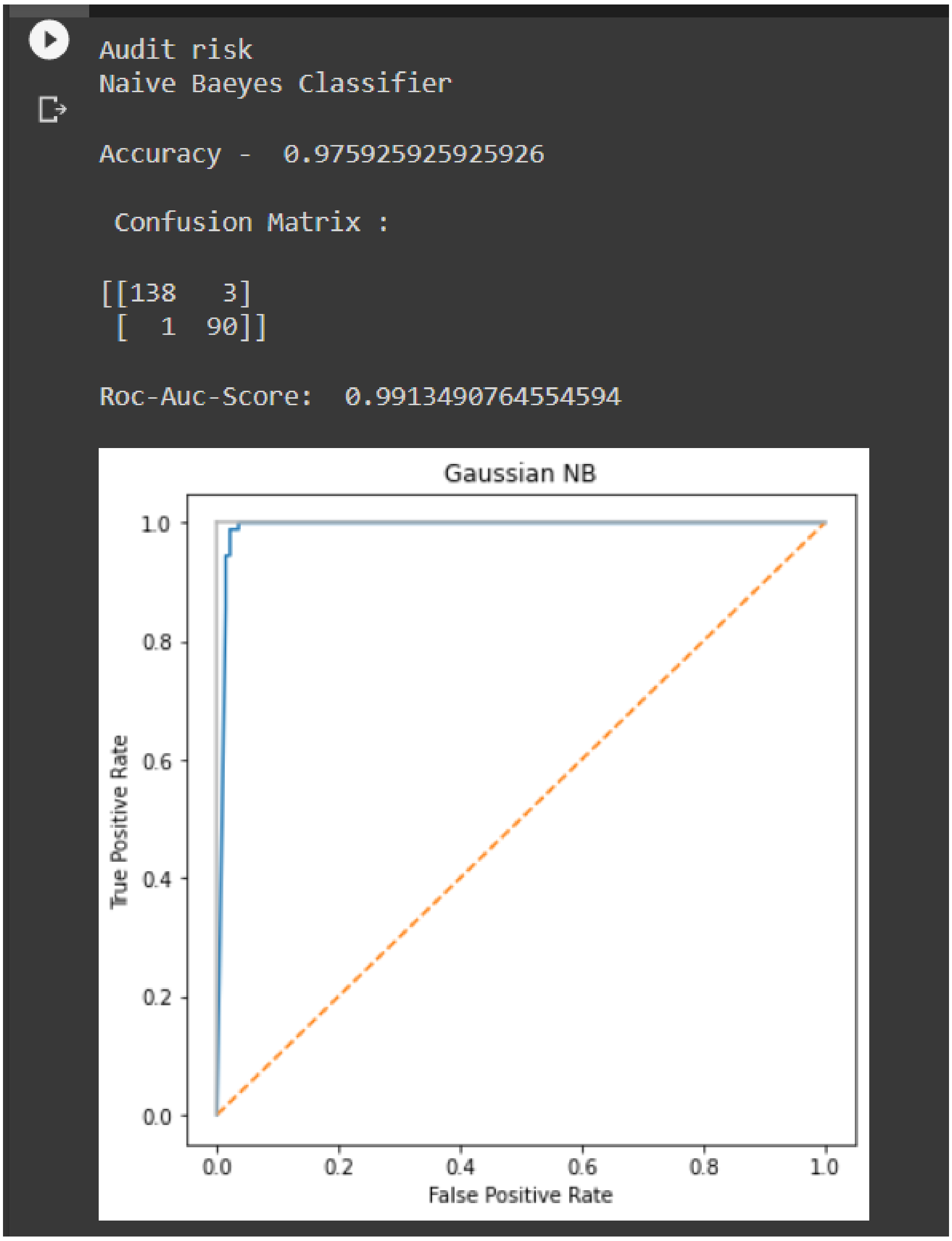
Dataset – 5 :

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import confusion_matrix, roc_curve, roc_auc_score, accuracy_score, classification_report
import matplotlib.pyplot as plt
from sklearn import tree
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import cross_val_score
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import LabelEncoder
import seaborn as sns

#Dataframe creation
df = pd.read_csv("/content/audit_data.csv")
df = df.dropna()

# Train test split
y = df.Risk
x = df.drop(['Risk'],axis=1)

X_train, X_val, Y_train, Y_val = train_test_split(x, y, test_size = 0.3, random_state=255)

# Gaussian model
gnb = GaussianNB()
gnb.fit(X_train, Y_train)

y_val_pred = gnb.predict(X_val)
y_train_pred = gnb.predict(X_train)
nb_audit = gnb.score(X_train, Y_train)*100

# Prediction and Confusion Matrix
print("Audit risk  ")
print("Naive Baeyes Classifier")
print(f"\nAccuracy - ", gnb.score(X_train, Y_train))
print(f"\n Confusion Matrix : \n")
con_matrix = confusion_matrix(Y_val,y_val_pred)
print(con_matrix)

#Plotting of AUCROC
y_score = gnb.predict_proba(X_val)[ :,1]
```

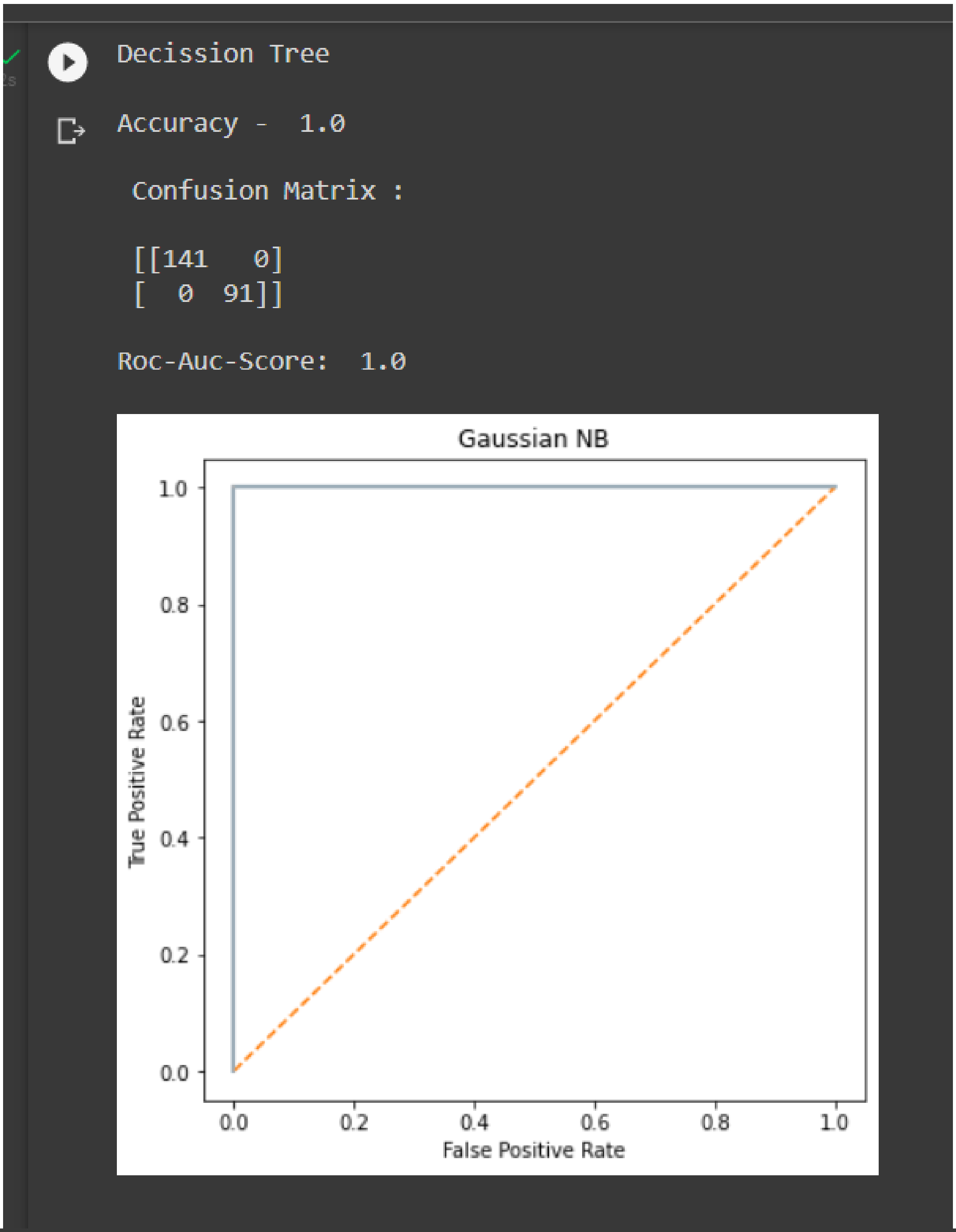
```
false_positive, true_positive, threshold = roc_curve(Y_val, y_score)
print("\nRoc-Auc-Score: ", roc_auc_score(Y_val, y_score))
print()

plt.subplots(1, figsize = (7, 7))
plt.title("Gaussian NB")
plt.plot(false_positive, true_positive)
plt.plot([0, 1], ls = "--")
plt.plot([0,0], [1,0], c="0.7"), plt.plot([1,1], c="0.7")
plt.ylabel("True Positive Rate")
plt.xlabel("False Positive Rate")
plt.show()

dt = DecisionTreeClassifier()
dt.fit(X_train, Y_train)

y_val_pred = dt.predict(X_val)
dt_audit = dt.score(X_val, Y_val)*100

#Prediction and Confusion Matrix
print("\n\nDecission Tree")
print(f"\nAccuracy - ", dt.score(X_val, Y_val))
print(f"\n Confusion Matrix : ")
print("\n", confusion_matrix(Y_val, y_val_pred))

#Plotting of AUCROC
y_score = dt.predict_proba(X_val)[ :,1]

false_positive, true_positive, threshold = roc_curve(Y_val, y_score)
print("\nRoc-Auc-Score: ", roc_auc_score(Y_val, y_score))
print()

plt.subplots(1, figsize = (7, 7))
plt.title("Gaussian NB")
plt.plot(false_positive, true_positive)
plt.plot([0, 1], ls = "--")
plt.plot([0,0], [1,0], c="0.7"), plt.plot([1,1], c="0.7")
plt.ylabel("True Positive Rate")
plt.xlabel("False Positive Rate")
plt.show()

# Kfolds cross validation
pipeline = make_pipeline(StandardScaler(), RandomForestClassifier(n_estimators=100, max_depth=4))
X = X_train
y = Y_train
scores = cross_val_score(pipeline, X, y, cv=10, n_jobs=1)
print('\n\nCross Validation accuracy scores: %s' % scores)

# Random Forest Classifier
m = RandomForestClassifier()
```

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3)
# print(X_train.head(), X_test.head(), y_train.head(), y_test.head())
m.fit(X_train, y_train)
print(f"\nAccuracy of Random forest classifier is {m.score(X_test, y_test)}"
)
```

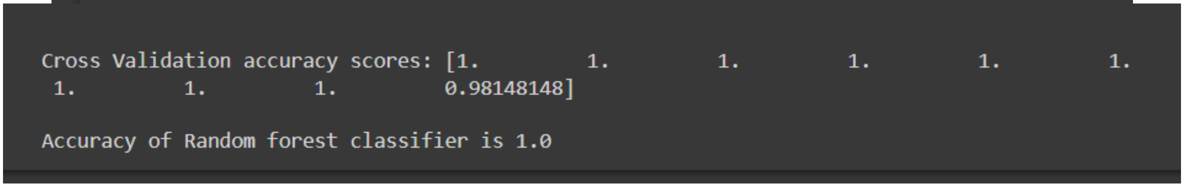
Output :-



```
Audit risk
Naive Baeyes Classifier

Accuracy -  0.975925925925926

 Confusion Matrix :

[[138   3]
 [  1  90]]

Roc-Auc-Score:  0.9913490764554594
```



```
Decission Tree

Accuracy -  1.0

 Confusion Matrix :

 [[141   0]
 [  0  91]]

Roc-Auc-Score:  1.0
```



```
Cross Validation accuracy scores: [1.         1.         1.         1.         1.         1.
 1.         1.         1.         0.98148148]

Accuracy of Random forest classifier is 1.0
```

Conclusion:

Thus, we have successfully implemented Classification algorithm using Decision Tree ID3 and Naïve Bayes algorithm