Assignment No. 5

Aim :

1. Logistic Regression
2. Differentiate between Linear and Logistic Regression
3. Sigmoid Function
4. Types of LogisticRegression
5. Confusion Matrix Evaluation Metrics

Code:

In [43]:
```
import numpy as np
import pandas as pd
import matplotlib as plt
```

In [44]:
```
data = pd.read_csv("diabetes.csv")
data
```

Out[44]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1
...	...	...	...	...	...	...	...	...	...
763	10	101	76	48	180	32.9	0.171	63	0
764	2	122	70	27	0	36.8	0.340	27	0
765	5	121	72	23	112	26.2	0.245	30	0
766	1	126	60	0	0	30.1	0.349	47	1
767	1	93	70	31	0	30.4	0.315	23	0

768 rows × 9 columns

In [45]:
```
data.head()
```

Out[45]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

In [46]:
```
data.tail()
```

Out[46]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
763	10	101	76	48	180	32.9	0.171	63	0
764	2	122	70	27	0	36.8	0.340	27	0
765	5	121	72	23	112	26.2	0.245	30	0
766	1	126	60	0	0	30.1	0.349	47	1
767	1	93	70	31	0	30.4	0.315	23	0

In [47]:
```
print("The shape of the data is: ")
data.shape
```

```
The shape of the data is:
```

Out[47]:
```
(768, 9)
```

In [48]:
```
print(data.isnull().sum())
```

```
Pregnancies                 0
Glucose                     0
BloodPressure               0
SkinThickness               0
Insulin                     0
BMI                         0
DiabetesPedigreeFunction    0
Age                         0
Outcome                     0
dtype: int64
```

In [49]:
```
X = data.iloc[:,0:13]
y = data.iloc[:,-1]
X
y
```

Out[49]:
```
0      1
1      0
2      1
3      0
4      1
      ..
763    0
764    0
765    0
766    1
767    0
Name: Outcome, Length: 768, dtype: int64
```

In [47]:
```
data["Outcome"].value_counts(normalize=True)
```

Out[47]:
```
Outcome
0    0.651042
1    0.348958
Name: proportion, dtype: float64
```

In [48]:
```
x=data.drop(["Outcome"],axis=1)
y=data["Outcome"]
```

In [49]:
```
x
```

Out[49]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age
0	6	148	72	35	0	33.6	0.627	50
1	1	85	66	29	0	26.6	0.351	31
2	8	183	64	0	0	23.3	0.672	32
3	1	89	66	23	94	28.1	0.167	21
4	0	137	40	35	168	43.1	2.288	33
...	...	...	...	...	...	...	...	...
763	10	101	76	48	180	32.9	0.171	63
764	2	122	70	27	0	36.8	0.340	27
765	5	121	72	23	112	26.2	0.245	30
766	1	126	60	0	0	30.1	0.349	47
767	1	93	70	31	0	30.4	0.315	23

768 rows × 8 columns

In [50]:
```
y
```

Out[50]:
```
0      1
1      0
2      1
3      0
4      1
      ..
763    0
764    0
765    0
766    1
767    0
Name: Outcome, Length: 768, dtype: int64
```

In [50]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.20,random_state=42)
```

In [51]:
```
print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(614, 9)
(154, 9)
(614,)
(154,)
```

In [51]:
```
from sklearn.preprocessing import MinMaxScaler
scaler=MinMaxScaler()
scaler
```

Out[51]:
```
MinMaxScaler
MinMaxScaler()
```

In [72]:
```
from sklearn.datasets import make_classification
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler

X, y = make_classification(random_state=42)
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=42)
pipe = make_pipeline(StandardScaler(), LogisticRegression())
pipe.fit(X_train, y_train)
```

Out[72]:
```
Pipeline
StandardScaler
LogisticRegression
```

In [78]:
```
from sklearn.linear_model import LogisticRegression
logreg = LogisticRegression()
logreg.fit(X_train,y_train)

```

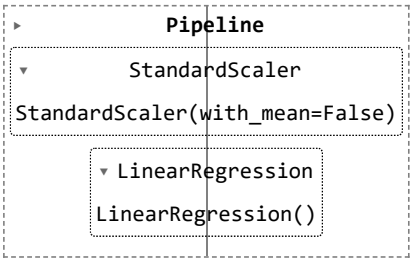
Out[78]:
```
LogisticRegression
LogisticRegression()
```

In [79]:
```
y_pred=logreg.predict(X_test)
```

In [80]:
```
from sklearn.linear_model import LinearRegression
```

In [81]:
```
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import make_pipeline
model = make_pipeline(StandardScaler(with_mean=False), LinearRegression())
model.fit(X_train, y_train)
```

Out[81]:



In [82]:
```
model.score(X_test,y_test)
```

Out[82]:
```
0.6803193862233878
```

In [83]:
```
X_train
```

Out[83]:
```
array([[-1.06239353, -2.68317954,  0.33848384, ..., -0.35316629,
         0.32579632,  0.1943843 ],
       [-0.79047446, -0.07873421, -1.69246463, ...,  1.09419152,
        -0.12578692,  0.05572491],
       [-0.22096417, -0.54561186, -0.57117899, ...,  0.64084286,
        -0.28110029,  1.79768653],
       ...,
       [ 0.84064355,  0.37531604, -0.96697614, ...,  0.42545756,
         0.76041466,  0.78580016],
       [ 0.49403019,  0.63067073,  1.1487657 , ..., -2.84854262,
        -0.37061433,  0.77169871],
       [-0.42018682, -0.24038388,  0.9843224 , ..., -0.99835404,
         0.23421473,  1.55050049]])
```

In [84]:
```
y_train
```

Out[84]:
```
array([1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 0, 0, 1, 0,
       1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 1,
       1, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1,
       1, 1, 1, 1, 1, 0, 1, 0, 1])
```

In [85]:
```
X_test
```

```
        -1.49518014e-01, -2.47164450e+00, -6.03985187e-01,
        -2.03045386e-01,  3.71145873e-01],
       [ 7.66080278e-01, -2.65461268e+00,  1.49268857e+00,
        -8.26880354e-01, -2.26478892e-01,  2.25661188e+00,
        -7.47211679e-01, -2.71123601e-01,  1.22693322e+00,
        -1.00154076e-01,  2.36867367e+00, -9.98385439e-01,
        -2.13672943e-02, -2.03673750e-01,  3.01791900e-01,
         1.17077461e+00, -8.77982587e-01, -8.03178951e-01,
         3.67365507e-01,  9.13584626e-01],
       [-6.22649362e-01, -1.44723231e+00, -1.50472037e+00,
        -3.70367970e-02, -4.29302225e-01,  1.25896077e+00,
        -1.45755150e+00,  7.60055964e-01,  1.94607455e-01,
        -7.42470586e-01,  1.27988990e+00,  4.36024464e-02,
         8.24397529e-02, -1.32002251e+00,  1.69505104e+00,
         6.63522604e-01, -6.11769091e-01, -8.31055726e-02,
        -6.92420980e-01, -1.40631746e+00],
       [-1.32633746e-01, -1.29826331e+00,  7.09451817e-01,
         8.47421677e-01, -5.35328186e-01,  1.25291095e+00,
        -2.59546678e-01, -4.35486371e-01, -9.74529305e-01,
         1.10708067e+00,  1.09885263e+00,  6.72573701e-01,
```

In [86]:
```
y_test
```

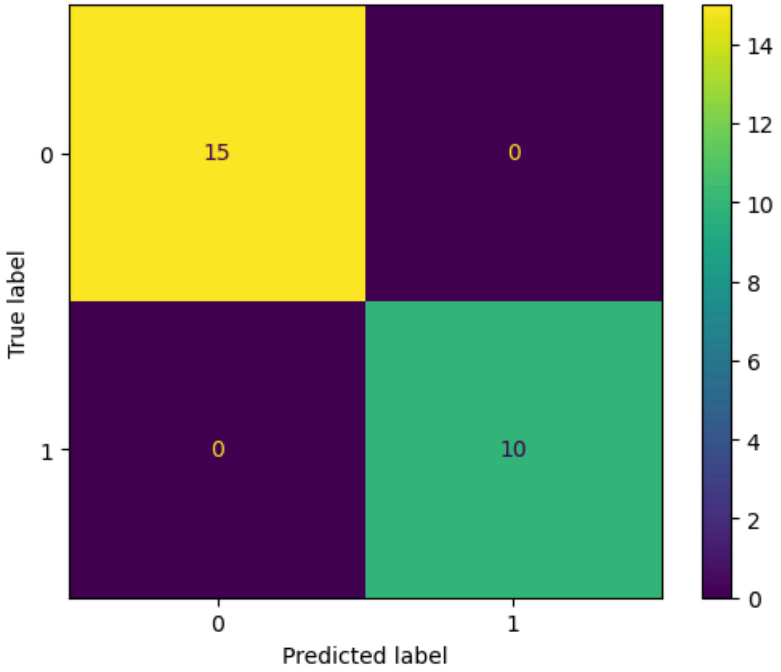
Out[86]:
```
array([0, 1, 1, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1,
       1, 1, 0])
```

In [96]:
```
from sklearn.metrics import precision_score,ConfusionMatrixDisplay, confusion_matrix,accuracy_s
cm= confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix = cm)
print("Confusion matrix :")
print(cm)
```

```
Confusion matrix :
[[15  0]
 [ 0 10]]
```

In [97]:
```
disp.plot()
```

Out[97]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x212f7a6c650>



In [98]:
```
true_negative =cm[0][0]
false_negative =cm[1][0]
false_positive =cm[0][1]
true_positive =cm[1][1]
```

In [99]:
```
Accuracy = (true_positive + true_negative) / (true_positive +false_positive + true_negative + f
Accuracy
# Precison
Precision = true_positive/(true_positive+false_positive)
Precision
# Recall
Recall = true_positive/(true_positive+false_negative)
Recall
# F1 Score
F1_Score = 2*(Recall * Precision) / (Recall + Precision)
F1_Score
```

Out[99]: 1.0

In [100]:
```
print("Accuracy:", Accuracy)
print("Confusion Matrix:")
print(cm)
print("\nClassification Report:")
print(classification_report(y_test, y_pred))
```

```
Accuracy: 1.0
Confusion Matrix:
[[15  0]
 [ 0 10]]

Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        15
           1       1.00      1.00      1.00        10

    accuracy                           1.00        25
   macro avg       1.00      1.00      1.00        25
weighted avg       1.00      1.00      1.00        25
```

In [102]:
```
Accuracy
```

Out[102]: 1.0

In [103]:
```
Precision
```

Out[103]: 1.0

In [104]:
```
Recall
```

Out[104]: 1.0

In [105]:
```
F1_Score
```

Out[105]: 1.0

In [116]:
```
from sklearn.metrics import f1_score, confusion_matrix, roc_auc_score, roc_curve
import matplotlib as plt
```

In [117]:
```
auc_score=roc_auc_score(y_test,y_pred)
```

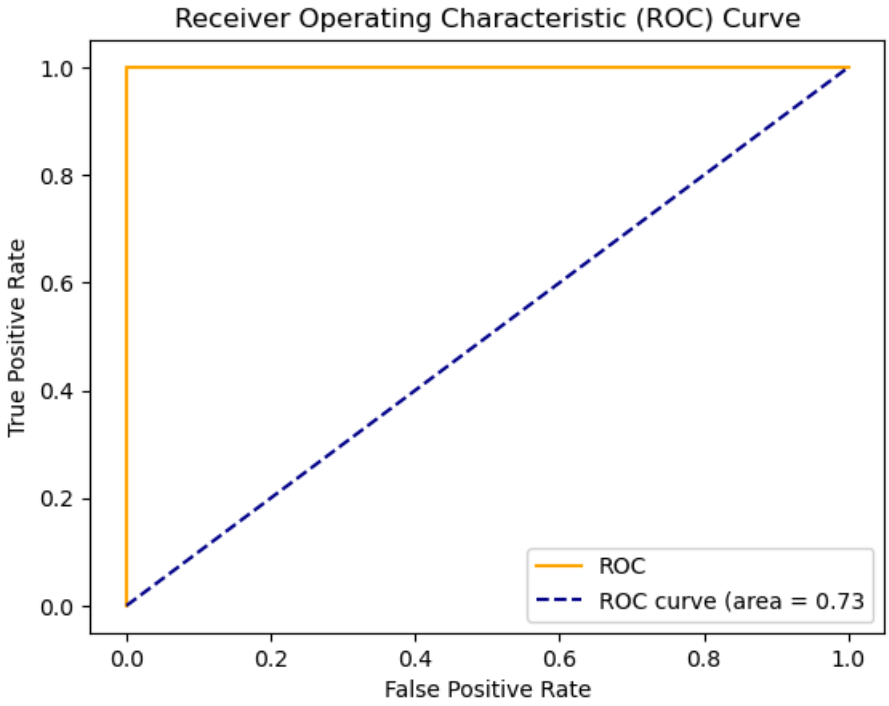
In [118]:
```
fpr,tpr,threasholds=roc_curve(y_test,y_pred)
```

In [119]:
```
threasholds
```

Out[119]: array([2, 1, 0])

In [124]:

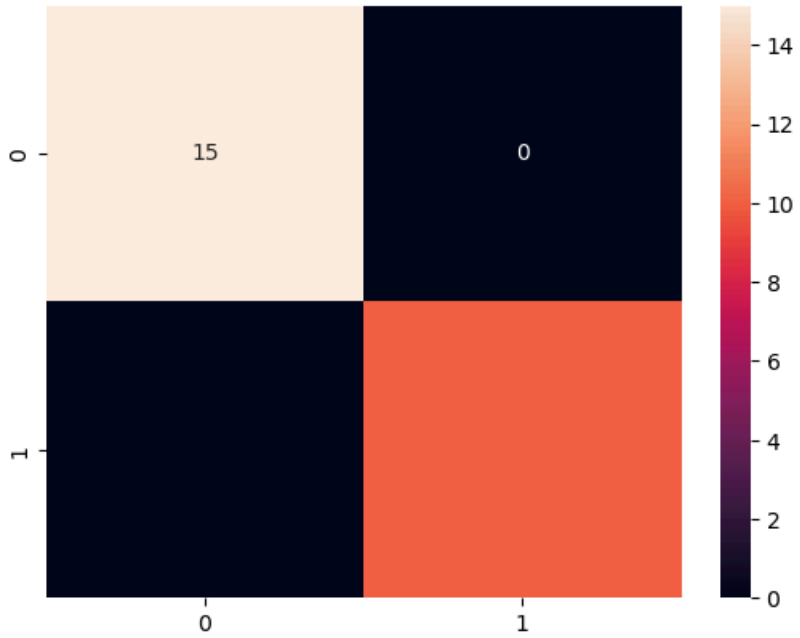
```
import matplotlib.pyplot as plt
plt.plot(fpr, tpr, color='orange', label='ROC')
plt.plot([0, 1], [0, 1], color='darkblue', linestyle='--',label='ROC curve (area = 0.73')
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('Receiver Operating Characteristic (ROC) Curve')
plt.legend()
plt.show()
```



In [125]:

```
import seaborn as sns
sns.heatmap(cm, annot=True)
```

Out[125]: <Axes: >



Name : Mohan Kadambande

Roll No. : 13212 (TECO-b1)