## Roll NO : 31444

## Assignment : 5

## Data Analytics II

1. Implement logistic regression using Python/R to perform classification on Social_Network_Ads.csv dataset.
2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.

In [ ]:
```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import confusion_matrix
from matplotlib.colors import ListedColormap
from matplotlib import pyplot as plt
import seaborn as sb
```

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

In [ ]:
```
data
```

Out[ ]:

| | User ID | Gender | Age | EstimatedSalary | Purchased |
|---|---|---|---|---|---|
| **0** | 15624510 | Male | 19 | 19000 | 0 |
| **1** | 15810944 | Male | 35 | 20000 | 0 |
| **2** | 15668575 | Female | 26 | 43000 | 0 |
| **3** | 15603246 | Female | 27 | 57000 | 0 |
| **4** | 15804002 | Male | 19 | 76000 | 0 |
| **...** | ... | ... | ... | ... | ... |
| **395** | 15691863 | Female | 46 | 41000 | 1 |
| **396** | 15706071 | Male | 51 | 23000 | 1 |
| **397** | 15654296 | Female | 50 | 20000 | 1 |
| **398** | 15755018 | Male | 36 | 33000 | 0 |
| **399** | 15594041 | Female | 49 | 36000 | 1 |

400 rows × 5 columns

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

Out[ ]:

| | User ID | Gender | Age | EstimatedSalary | Purchased |
|---|---|---|---|---|---|
| **0** | 15624510 | Male | 19 | 19000 | 0 |
| **1** | 15810944 | Male | 35 | 20000 | 0 |
| **2** | 15668575 | Female | 26 | 43000 | 0 |
| **3** | 15603246 | Female | 27 | 57000 | 0 |
| **4** | 15804002 | Male | 19 | 76000 | 0 |

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

Out[ ]:
```
User ID            0
Gender             0
Age                0
EstimatedSalary    0
Purchased          0
dtype: int64
```

In [ ]:
```
data.dtypes
```

Out[ ]:
```
User ID             int64
Gender             object
Age                 int64
EstimatedSalary     int64
Purchased           int64
dtype: object
```

In [ ]:
```
data["Purchased"]=  data["Purchased"].astype('bool')
```

In [ ]:
```
data.dtypes
```

Out[ ]:
```
User ID             int64
Gender             object
Age                 int64
EstimatedSalary     int64
Purchased            bool
dtype: object
```

In [ ]:
```
X = data.iloc[:, [2, 3]].values
y = data.iloc[:, 4].values

print(X[:3, :])
print('-'*15)
print(y[:3])
```

```
[[   19 19000]
 [   35 20000]
 [   26 43000]]
---------------
[False False False]
```

In [ ]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, 

print(X_train[:3])
print('-'*15)
print(y_train[:3])
print('-'*15)
```

```
print(X_test[:3])
print('-'*15)
print(y_test[:3])
```

```
[[    58 144000]
 [    59  83000]
 [    24  55000]]
---------------
[ True False False]
---------------
[[   30 87000]
 [   38 50000]
 [   35 75000]]
---------------
[False False False]
```

In [ ]:
```
sc_X = StandardScaler()
X_train = sc_X.fit_transform(X_train)
X_test = sc_X.transform(X_test)
```

In [ ]:
```
from sklearn.linear_model import LogisticRegression
classifier = LogisticRegression(random_state = 0, solver='lbfgs' )
classifier.fit(X_train, y_train)
y_pred = classifier.predict(X_test)
```

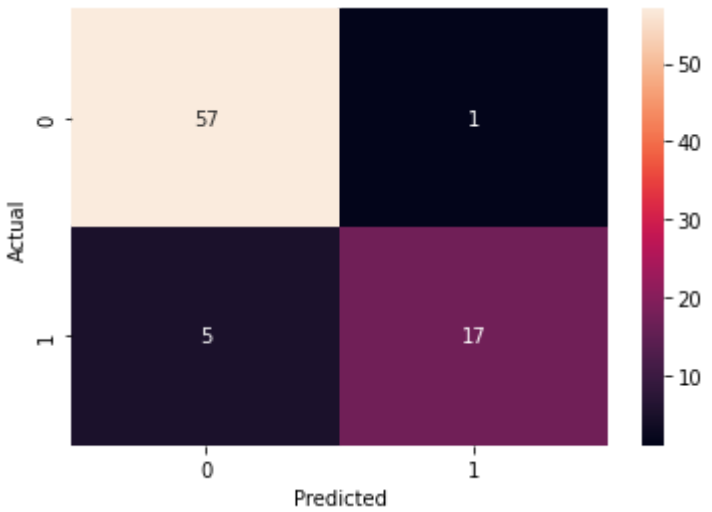
In [ ]:
```
r2score = classifier.score(X_test,y_test)
print("R2Score : "+str(r2score*100)+"%")
```

```
R2Score : 92.5%
```

## Confusion Matrix

In [ ]:
```
cm = confusion_matrix(y_test, y_pred)
sb.heatmap(cm,annot=True).set(xlabel='Predicted', ylabel='Actual')
```

Out[ ]:
```
[Text(0.5, 15.0, 'Predicted'), Text(33.0, 0.5, 'Actual')]
```




In [ ]:
```
tn = cm[0][0]
tp = cm[1][1]
fn = cm[1][0]
fp = cm[0][1]
```

In [ ]:
```
print("Precision  : ",tp/(tp+fp)*100,"%")
print("Recall     : ",tp/(tp+fn)*100,"%")
print("Error Rate : ",(fn+fp)/(fn+fp+tn+tp)*100,"%")
print("Accuracy   : ",(tp+tn)/(tp+tn+fp+fn)*100,"%")
```

```
Precision  :  94.44444444444444 %
Recall     :  77.27272727272727 %
Error Rate :  7.5 %
Accuracy   :  92.5 %
```

In [ ]:
```
X_set, y_set = X_train, y_train
X1, X2 = np.meshgrid(np.arange(start = X_set[:, 0].min() - 1, stop = X_set[
                     np.arange(start = X_set[:, 1].min() - 1, stop = X_set[
plt.contourf(X1, X2, classifier.predict(np.array([X1.ravel(), X2.ravel()]).'
             alpha = 0.6, cmap = ListedColormap(('red', 'green')))
plt.xlim(X1.min(), X1.max())
plt.ylim(X2.min(), X2.max())
for i, j in enumerate(np.unique(y_set)):
    plt.scatter(X_set[y_set == j, 0], X_set[y_set == j, 1],
                c = ListedColormap(('red', 'green'))(i), label = j)
plt.title('Logistic Regression (Training set)')
plt.xlabel('Age')
plt.ylabel('Estimated Salary')
plt.legend()
plt.show()
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should
be avoided as value-mapping will have precedence in case its length matches
with *x* & *y*.  Please use the *color* keyword-argument or provide a 2D arr
ay with a single row if you intend to specify the same RGB or RGBA value for
all points.
*c* argument looks like a single numeric RGB or RGBA sequence, which should
be avoided as value-mapping will have precedence in case its length matches
with *x* & *y*.  Please use the *color* keyword-argument or provide a 2D arr
ay with a single row if you intend to specify the same RGB or RGBA value for
all points.
```


In [ ]:
```
X_set, y_set = X_test, y_test
X1, X2 = np.meshgrid(np.arange(start = X_set[:, 0].min() - 1, stop = X_set[
                     np.arange(start = X_set[:, 1].min() - 1, stop = X_set[
plt.contourf(X1, X2, classifier.predict(np.array([X1.ravel(), X2.ravel()]).'
             alpha = 0.6, cmap = ListedColormap(('red', 'green')))
plt.xlim(X1.min(), X1.max())
plt.ylim(X2.min(), X2.max())
for i, j in enumerate(np.unique(y_set)):
```

```
    plt.scatter(X_set[y_set == j, 0], X_set[y_set == j, 1],
                c = ListedColormap(('red', 'green'))(i), label = j)
plt.title('Logistic Regression (Test set)')
plt.xlabel('Age')
plt.ylabel('Estimated Salary')
plt.legend()
plt.show()
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should
be avoided as value-mapping will have precedence in case its length matches
with *x* & *y*.  Please use the *color* keyword-argument or provide a 2D arr
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ay with a single row if you intend to specify the same RGB or RGBA value for
all points.
```