Assignment - 5 _ Data Analytics 2 -Logestic Regression

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TE Comp 1

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.

Loading Social_Network_Ads.csv dataset

In [5]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

df = pd.read_csv('Social_Network_Ads.csv')
df.head()
```

Out[5]:

	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

Purchased is the binary data thus it is called the Dependable variable and Age, EstimatedSalary are independent variables

In [6]:
```
df['Purchased'].value_counts()
```

Out[6]:
```
0    257
1    143
Name: Purchased, dtype: int64
```

In [7]:
```
df = df.drop('User ID', axis = 1)
df.head()
```

Out[7]:

	Gender	Age	EstimatedSalary	Purchased
0	Male	19	19000	0
1	Male	35	20000	0
2	Female	26	43000	0
3	Female	27	57000	0
4	Male	19	76000	0

In [8]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 4 columns):
 #   Column           Non-Null Count  Dtype 
---  ------           --------------  ----- 
 0   Gender           400 non-null    object
 1   Age              400 non-null    int64 
 2   EstimatedSalary  400 non-null    int64 
 3   Purchased        400 non-null    int64 
dtypes: int64(3), object(1)
memory usage: 12.6+ KB
```

In [9]:

```
from sklearn.preprocessing import OneHotEncoder
df_onehot = pd.get_dummies(df, columns=['Gender'], prefix = ['Gender'])
df_onehot.head(10)
```

Out[9]:

	Age	EstimatedSalary	Purchased	Gender_Female	Gender_Male
0	19	19000	0	0	1
1	35	20000	0	0	1
2	26	43000	0	1	0
3	27	57000	0	1	0
4	19	76000	0	0	1
5	27	58000	0	0	1
6	27	84000	0	1	0
7	32	150000	1	1	0
8	25	33000	0	0	1
9	35	65000	0	1	0

Data Transformation of Gender into Male and Female gender using 0 and 1

In [10]:

```
from sklearn.preprocessing import MinMaxScaler

scaler=MinMaxScaler(feature_range=(0,1))
```

```
df_onehot["EstimatedSalary"]=scaler.fit_transform(df_onehot[["EstimatedSalary"]])
Column_loc = ['Age','EstimatedSalary','Gender_Female','Gender_Male','Purchased']
df_onehot = df_onehot[Column_loc]
df_onehot.head(5)
```

Out[10]:

	Age	EstimatedSalary	Gender_Female	Gender_Male	Purchased
0	19	0.029630	0	1	0
1	35	0.037037	0	1	0
2	26	0.207407	1	0	0
3	27	0.311111	1	0	0
4	19	0.451852	0	1	0

Initializaing dependent and independent variables

In [11]:

```
X = df_onehot.iloc[:,:-1].values
print(X)
y = df_onehot.iloc[:,-1].values
```

```
[[1.90000000e+01 2.96296296e-02 0.00000000e+00 1.00000000e+00]
 [3.50000000e+01 3.70370370e-02 0.00000000e+00 1.00000000e+00]
 [2.60000000e+01 2.07407407e-01 1.00000000e+00 0.00000000e+00]
 ...
 [5.00000000e+01 3.70370370e-02 1.00000000e+00 0.00000000e+00]
 [3.60000000e+01 1.33333333e-01 0.00000000e+00 1.00000000e+00]
 [4.90000000e+01 1.55555556e-01 1.00000000e+00 0.00000000e+00]]
```

Applying train, test, split operatoin on dataset

In [12]:

```
from sklearn.model_selection import train_test_split
train_X, test_X, train_y, test_y = train_test_split(X, y, test_size= 0.25, random_state
print(train_X.shape,train_y.shape,test_X.shape,test_y.shape)
```

```
(300, 4) (300,) (100, 4) (100,)
```

Logistic Regression

Logistic Regression was used in the biological sciences in early twentieth century. It was then used in many social science applications. Logistic Regression is used when the dependent variable(target) is categorical.
For example,

- To predict whether an email is spam (1) or (0)
- Whether the tumor is malignant (1) or not (0)

Applying logistic regression on trained data

In [13]:
```
from sklearn.linear_model import LogisticRegression
lr = LogisticRegression()
lr.fit(train_X,train_y)    #fitting trainable data
```

Out[13]:
```
LogisticRegression()
```

In [14]:
```
#pridicting Y value using test_X
predict_y = lr.predict(test_X)
predict_y
```

Out[14]:
```
array([0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 1, 0, 0, 0, 0,
       0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0,
       1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1], dtype=int64)
```

Calculating accuracy

In [15]:
```
from sklearn.metrics import accuracy_score
accuracy_score(test_y, predict_y)
```

Out[15]:
```
0.86
```

Calulating - Precision and Recall

In [16]:
```
from sklearn.metrics import confusion_matrix, precision_score, recall_score
print(precision_score(test_y, predict_y))
print(recall_score(test_y, predict_y))
```

```
0.8076923076923077
0.7
```

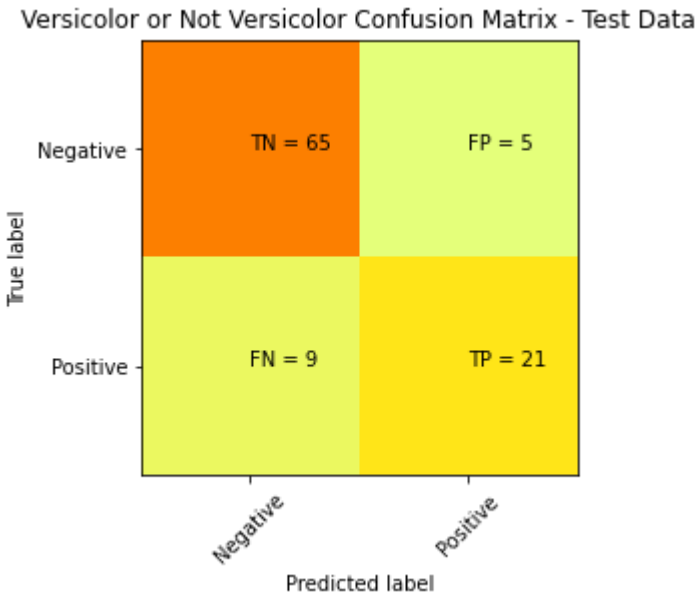
Confusion Matrix

In [17]:
```
print(confusion_matrix(test_y, predict_y))
tp,fp, fn, tn = confusion_matrix(test_y, predict_y).ravel()
```

```
[[65  5]
 [ 9 21]]
```

In [24]:
```
plt.clf()
plt.imshow(cm, interpolation='nearest', cmap=plt.cm.Wistia)
classNames = ['Negative','Positive']
plt.title('Versicolor or Not Versicolor Confusion Matrix - Test Data')
plt.ylabel('True label')
plt.xlabel('Predicted label')
tick_marks = np.arange(len(classNames))
plt.xticks(tick_marks, classNames, rotation=45)
plt.yticks(tick_marks, classNames)
s = [['TN','FP'], ['FN', 'TP']]
for i in range(2):
    for j in range(2):
```

```
        plt.text(j,i, str(s[i][j])+" = "+str(cm[i][j]))
plt.show()
```



TP FP FN TN

In [19]:
```
print(f'Correctly Predicted made Purchase {tp}')
print(f'Falsely Predicted made Purchase {fp}')
print(f'Falsely Predicted made did NOT made Purchase {fn}')
print(f'Correctly Predicted made did NOT made Purchase {tn}')
```

```
Correctly Predicted made Purchase 65
Falsely Predicted made Purchase 5
Falsely Predicted made did NOT made Purchase 9
Correctly Predicted made did NOT made Purchase 21
```

In [20]:
```
Result_Test_X = pd.DataFrame(test_X, columns =['Age','EstimatedSalary','Gender_Female',
Result_Predict_y = pd.DataFrame(predict_y, columns= ['Pred_Purchase'])
pd.concat([Result_Test_X, Result_Predict_y], axis=1)
```

Out[20]:

	Age	EstimatedSalary	Gender_Female	Gender_Male	Pred_Purchase
0	33.0	0.333333	1.0	0.0	0
1	27.0	0.511111	1.0	0.0	0
2	25.0	0.533333	0.0	1.0	0
3	38.0	0.259259	1.0	0.0	0
4	27.0	0.540741	0.0	1.0	0
...	...	...	...	...	...
95	45.0	0.222222	1.0	0.0	0
96	32.0	0.777778	0.0	1.0	0
97	21.0	0.422222	0.0	1.0	0

	Age	EstimatedSalary	Gender_Female	Gender_Male	Pred_Purchase
98	45.0	0.125926	0.0	1.0	0
99	48.0	0.911111	1.0	0.0	1

100 rows × 5 columns

In [21]:
```
Result_test_y = pd.DataFrame(test_y, columns= ['Purchased'])
Result = pd.concat([Result_Test_X, Result_test_y, Result_Predict_y], axis=1)
Result
```

Out[21]:

	Age	EstimatedSalary	Gender_Female	Gender_Male	Purchased	Pred_Purchase
0	33.0	0.333333	1.0	0.0	0	0
1	27.0	0.511111	1.0	0.0	0	0
2	25.0	0.533333	0.0	1.0	0	0
3	38.0	0.259259	1.0	0.0	0	0
4	27.0	0.540741	0.0	1.0	0	0
...	...	...	...	...	...	...
95	45.0	0.222222	1.0	0.0	1	0
96	32.0	0.777778	0.0	1.0	1	0
97	21.0	0.422222	0.0	1.0	0	0
98	45.0	0.125926	0.0	1.0	1	0
99	48.0	0.911111	1.0	0.0	1	1

100 rows × 6 columns

In [22]:
```
# Comparing test_y and predicted_y values and saving
Result.to_csv('./Final_Prediction_test_values.csv')
```

In [ ]:
```

```