Importing Libraries

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from matplotlib.colors import ListedColormap
from sklearn import metrics
import seaborn as sns
%matplotlib inline
import warnings;
warnings.filterwarnings('ignore');
```

Importing Dataset

```
dataset=pd.read_csv('Social_Network_Ads.csv')
dataset
```

```
      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 x 5 columns]
```

Extracting Variables

```
X = dataset.iloc[:,[2,3]].values
X
```

```
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Y = dataset.iloc[:,4].values
Y
```

```
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1,
       1, 1, 0, 1])
```
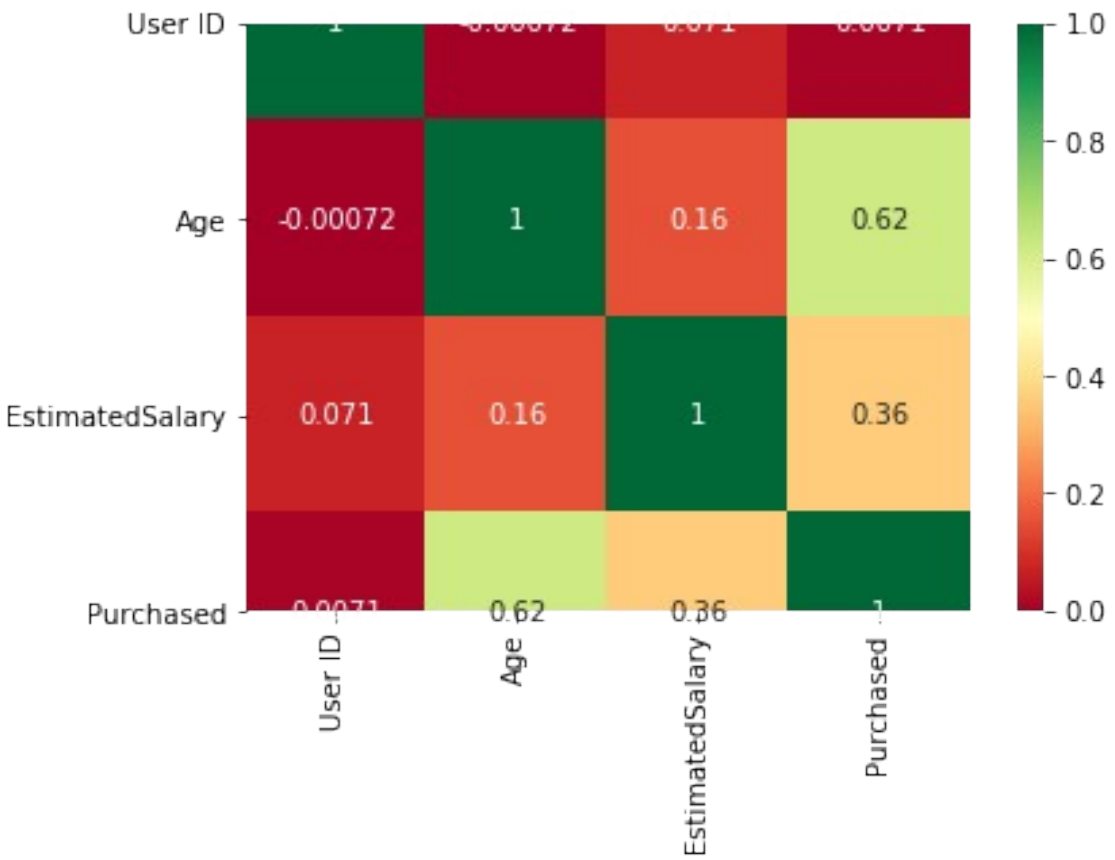

Heatmap to see correlation

```
sns.heatmap(dataset.corr(), annot = True, cmap = 'RdYlGn')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7ff142682910>
```



Train Test Split

```
X_train,x_test,y_train,y_test=train_test_split(X,Y,test_size=1/3,rando
m_state=32)
```

Feature Scaling

```
standard_Scaler=StandardScaler()
X_train = standard_Scaler.fit_transform(X_train)
x_test = standard_Scaler.transform(x_test)

x_test
```

```
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       [ 0.96047103, -1.42351012],
       [-1.22316396, -1.45373471],
       [ 0.96047103, -1.21193797],
       [ 0.36493421, -0.57722154],
       [-0.42911487,  2.38478851],
       [-1.12390783,  1.44782615],
       [-0.2306026 , -1.45373471],
       [-1.91795691,  0.35974082],
       [-0.03209033,  0.29929164],
       [-0.52837101,  1.41760155],
       [ 1.65526398,  1.02468185],
       [-0.13134647,  1.65939829],
       [ 1.25823944, -0.78879368],
       [-1.6201885 ,  0.54108838],
       [-0.72688328,  0.29929164],
       [-0.82613942, -0.81901828],
       [ 0.26567808, -0.39587398]])
```

Instantiating and fitting the model to training Dataset

```
log_reg=LogisticRegression(random_state=0)
log_reg.fit(X_train,y_train)

LogisticRegression(C=1.0, class_weight=None, dual=False,
fit_intercept=True,
                   intercept_scaling=1, l1_ratio=None, max_iter=100,
                   multi_class='warn', n_jobs=None, penalty='l2',
                   random_state=0, solver='warn', tol=0.0001,
verbose=0,
                   warm_start=False)
```

Prediction for Test Dataset

```
y_pred=log_reg.predict(x_test)
y_pred

array([1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 1,
0,
       1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1,
0,
       0, 1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 1,
0,
       1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 0,
1,
```

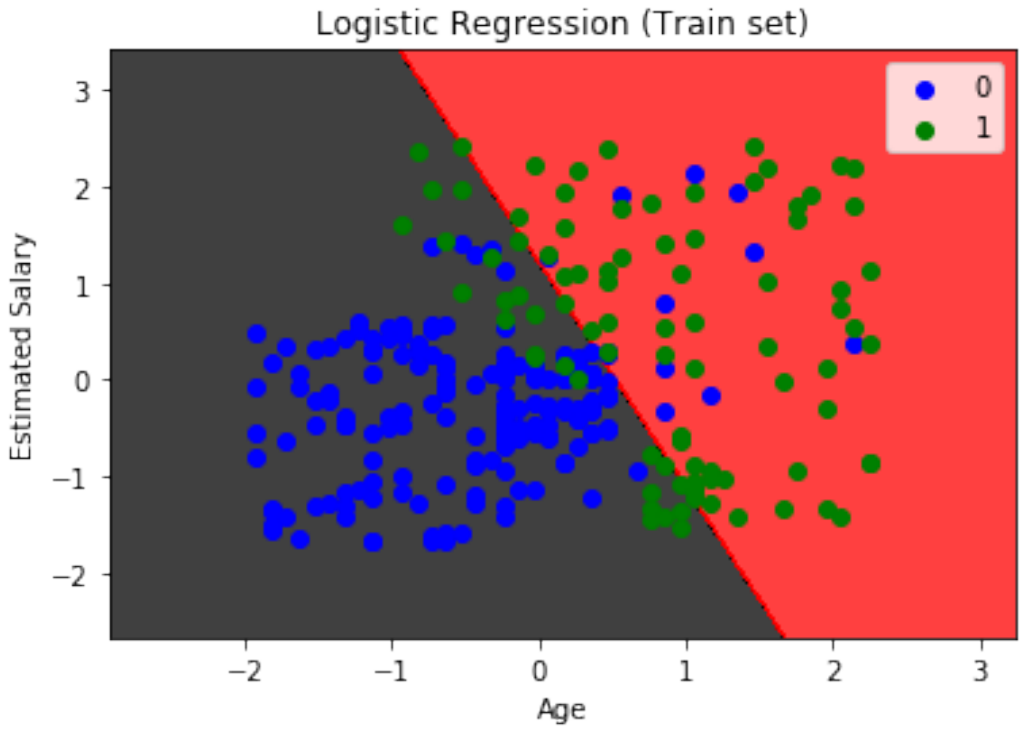
```
       1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0,
0,
       0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0,
0,
       0, 0])

y_test

array([1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 1,
0,
       1, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1,
0,
       0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1,
0,
       0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1,
1,
       1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0,
0,
       0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0,
0,
       0, 0])
```

Visualizing the Training Set Result

```
X_set,y_set = X_train,y_train
X1,X2 = np.meshgrid(np.arange(start=X_set[:,0].min() -
1,stop=X_set[:,0].max()+1,step=0.01),
                    np.arange(start=X_set[:,1].min() -
1,stop=X_set[:,1].max()+1,step=0.01))
plt.contourf(X1,X2,log_reg.predict(np.array([X1.ravel(),X2.ravel()]).T
).reshape(X1.shape),

alpha=0.75,cmap=ListedColormap(('black','red')))

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(['blue','green'])(i),label=j)

plt.title('Logistic Regression (Train 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 a 2-D array with a single
row if you really want 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 a 2-D array with a single
row if you really want to specify the same RGB or RGBA value for all
points.
```

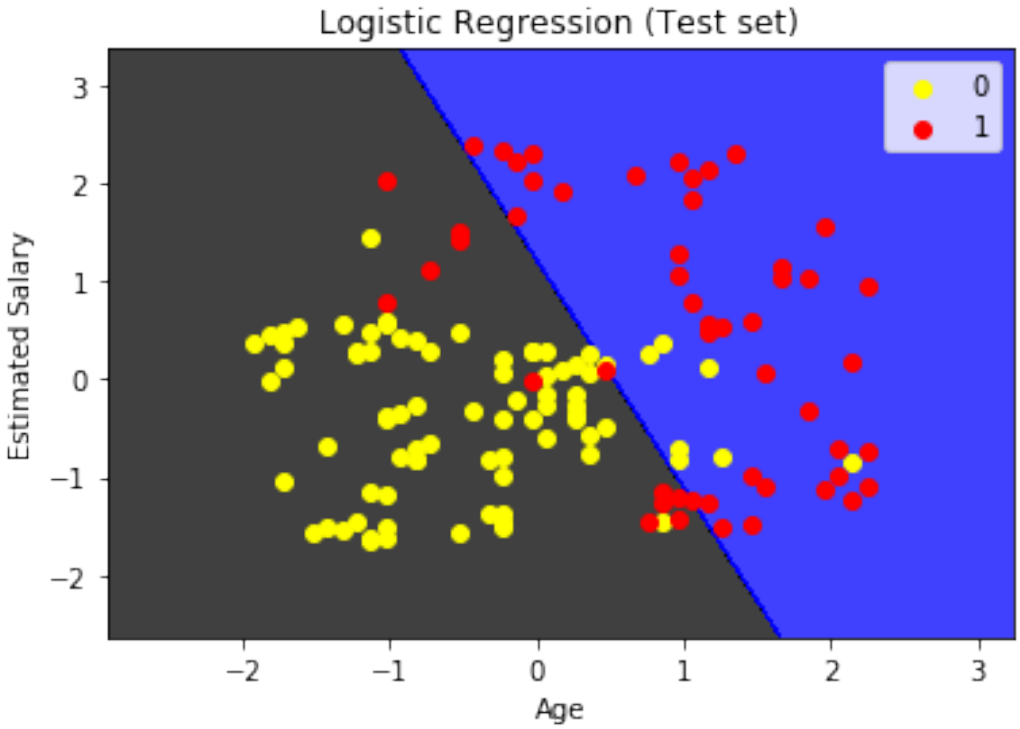


Visualizing the Testing Set results

```
X_set,y_set = x_test,y_test
X1,X2 = np.meshgrid(np.arange(start=X_set[:,0].min() -
1,stop=X_set[:,0].max()+1,step=0.01),
                    np.arange(start=X_set[:,1].min() -
1,stop=X_set[:,1].max()+1,step=0.01))
plt.contourf(X1,X2,log_reg.predict(np.array([X1.ravel(),X2.ravel()]).T
).reshape(X1.shape),

alpha=0.75,cmap=ListedColormap(('black','blue')))

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(['yellow','red'])(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 a 2-D array with a single
row if you really want 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 a 2-D array with a single
row if you really want to specify the same RGB or RGBA value for all
points.
```



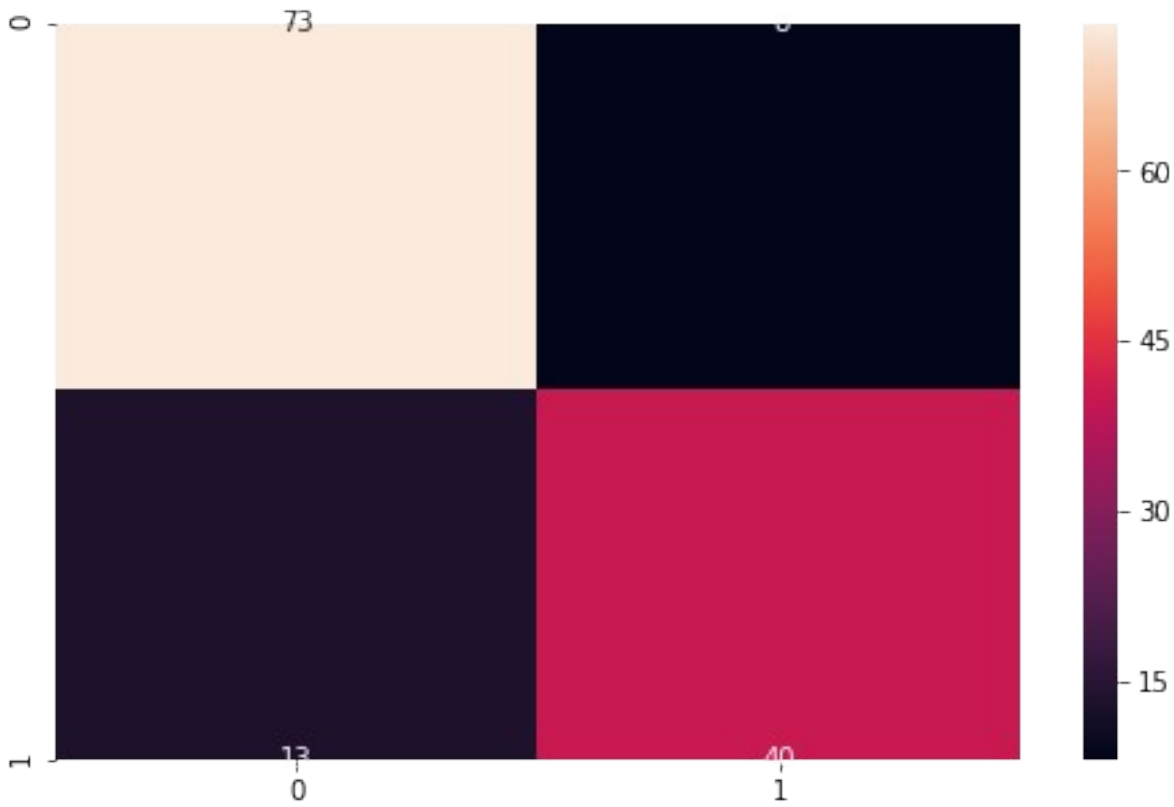
Confusion Matrix

```
from sklearn.metrics import confusion_matrix
conf_matrix = confusion_matrix(y_test,y_pred)
conf_matrix
```

```
array([[73,  8],
       [13, 40]])
```

```
import seaborn as sns
fig, ax = plt.subplots(figsize=(8,5))
sns.heatmap(conf_matrix, annot = True, ax=ax)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7ff143036290>
```




```
# fig, ax = plt.subplots()
# sns.heatmap(ax=ax)
```

Accuracy

```
accuracy = (73+40)/len(y_test)
accuracy
```

```
0.8432835820895522
```

Mis Classification Rate

```
mis_cla_rate  = (13+8)/len(y_test)
mis_cla_rate
```

```
0.15671641791044777
```

Accuracy, Precision, Recall etc

```
print("Accuracy: ", metrics.accuracy_score(y_test,y_pred))
```

```
Accuracy:  0.8432835820895522
```

```
print("Precision: ", metrics.precision_score(y_test,y_pred))
```

```
Precision:  0.8333333333333334
```

```
print("Recall: ", metrics.recall_score(y_test,y_pred))

Recall:  0.7547169811320755
```

ROC and AUC

```
y_pred_proba = log_reg.predict_proba(x_test)[::,1]
fpr, tpr, _ = metrics.roc_curve(y_test,  y_pred_proba)
auc = metrics.roc_auc_score(y_test, y_pred_proba)
plt.figure(figsize=(12,10))
plt.plot(fpr,tpr,label="auc="+str(auc))
plt.legend(loc=4)
plt.title("Receiver Operating Characteristic Curve (ROC)")
plt.xlabel("FPR ---->")
plt.ylabel("TPR ---->")
plt.show()
```