In [1]:
```
#6.  Data Analytics II:
#Implement logistic regression using Python/R to perform classification on Soc
#ComputeConfusionmatrixtofindTP,FP,TN,FN,Accuracy,Errorrate,Precision,Recall c

#Social_Network_Ads.csv
```

In [2]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import seaborn as sns

from IPython.core.interactiveshell
import InteractiveShell
InteractiveShell.ast_node_interactivity = "all"
```

In [3]:
```
df = pd.read_csv('Social_Network_Ads.csv')
df.head()
df.info()
df.describe()
```

Out[3]:

	User ID	Gender	Age	EstimatedSalary	Purchased
0	15624510	Male	19.0	19000.0	0
1	15810944	Male	35.0	20000.0	0
2	15668575	Female	26.0	43000.0	0
3	15603246	Female	27.0	57000.0	0
4	15804002	Male	19.0	76000.0	0

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 5 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   User ID          400 non-null    int64  
 1   Gender           400 non-null    object 
 2   Age              400 non-null    float64
 3   EstimatedSalary  400 non-null    float64
 4   Purchased        400 non-null    int64  
dtypes: float64(2), int64(2), object(1)
memory usage: 15.8+ KB
```

Out[3]:

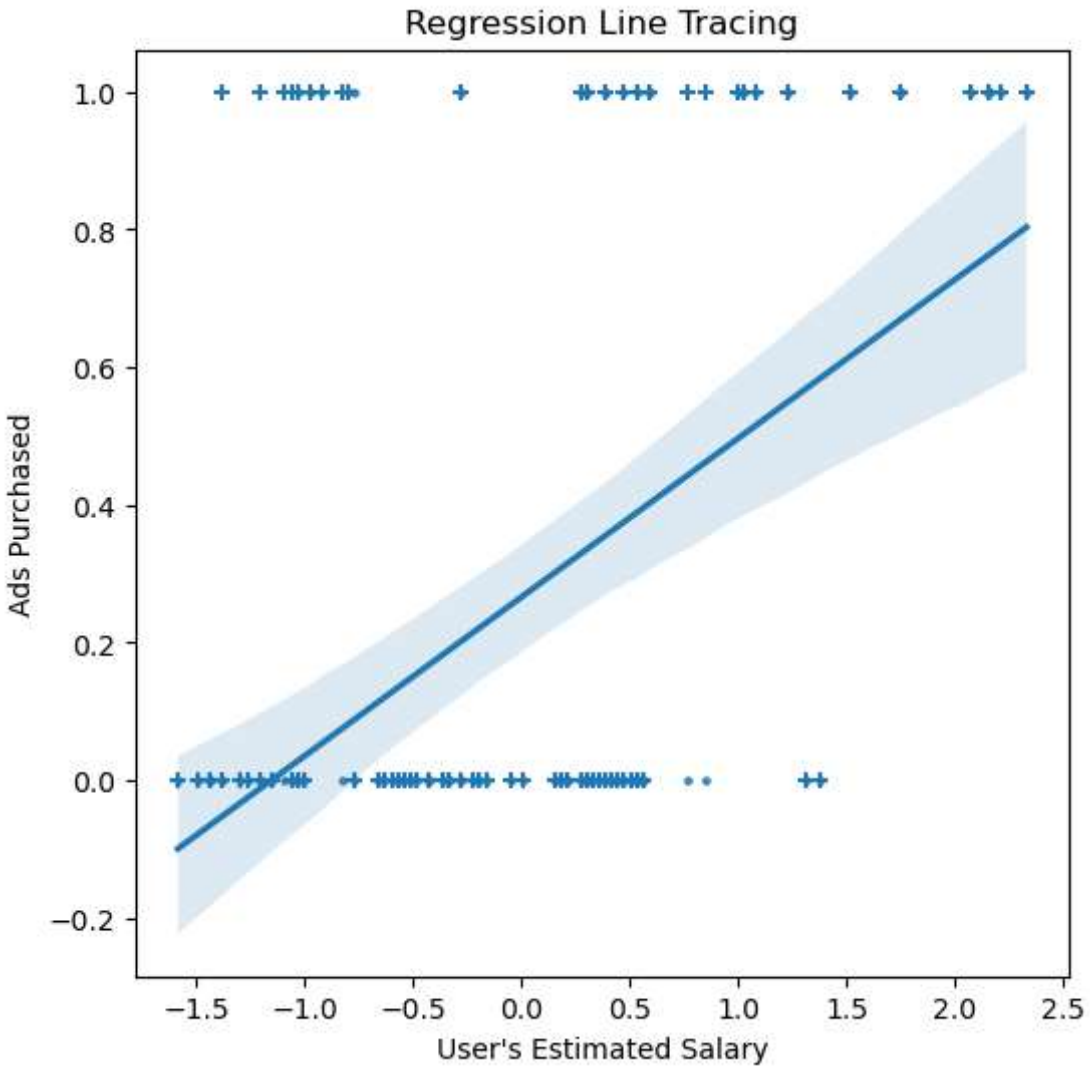
	User ID	Age	EstimatedSalary	Purchased
count	4.000000e+02	400.000000	400.000000	400.000000
mean	1.569154e+07	37.655000	69742.500000	0.357500
std	7.165832e+04	10.482877	34096.960282	0.479864
min	1.556669e+07	18.000000	15000.000000	0.000000
25%	1.562676e+07	29.750000	43000.000000	0.000000
50%	1.569434e+07	37.000000	70000.000000	0.000000
75%	1.575036e+07	46.000000	88000.000000	1.000000
max	1.581524e+07	60.000000	150000.000000	1.000000

In [4]:
```
X = df[['Age', 'EstimatedSalary']]
Y = df['Purchased']
```

In [5]:
```
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler

X_train, X_test, Y_train, Y_test = train_test_split
(X, Y, test_size = 0.25, random_state = 0)
sc_X = StandardScaler()
X_train = sc_X.fit_transform(X_train)
X_test = sc_X.transform(X_test)

print(f'Train Dataset Size - X: {X_train.shape}, Y:
      {Y_train.shape}')
print(f'Test  Dataset Size - X: {X_test.shape}, Y:
      {Y_test.shape}')
```

```
Train Dataset Size - X: (300, 2), Y: (300,)
Test  Dataset Size - X: (100, 2), Y: (100,)
```

In [6]:
```
from sklearn.linear_model import LogisticRegression

lm = LogisticRegression(random_state = 0, solver='lbfgs' )
lm.fit(X_train, Y_train)
predictions = lm.predict(X_test)

plt.figure(figsize=(6, 6));
sns.regplot(x = X_test[:, 1], y = predictions,
            scatter_kws={'s':5});
plt.scatter(X_test[:, 1], Y_test, marker = '+');
plt.xlabel("User's Estimated Salary");
plt.ylabel('Ads Purchased');
plt.title('Regression Line Tracing');
```

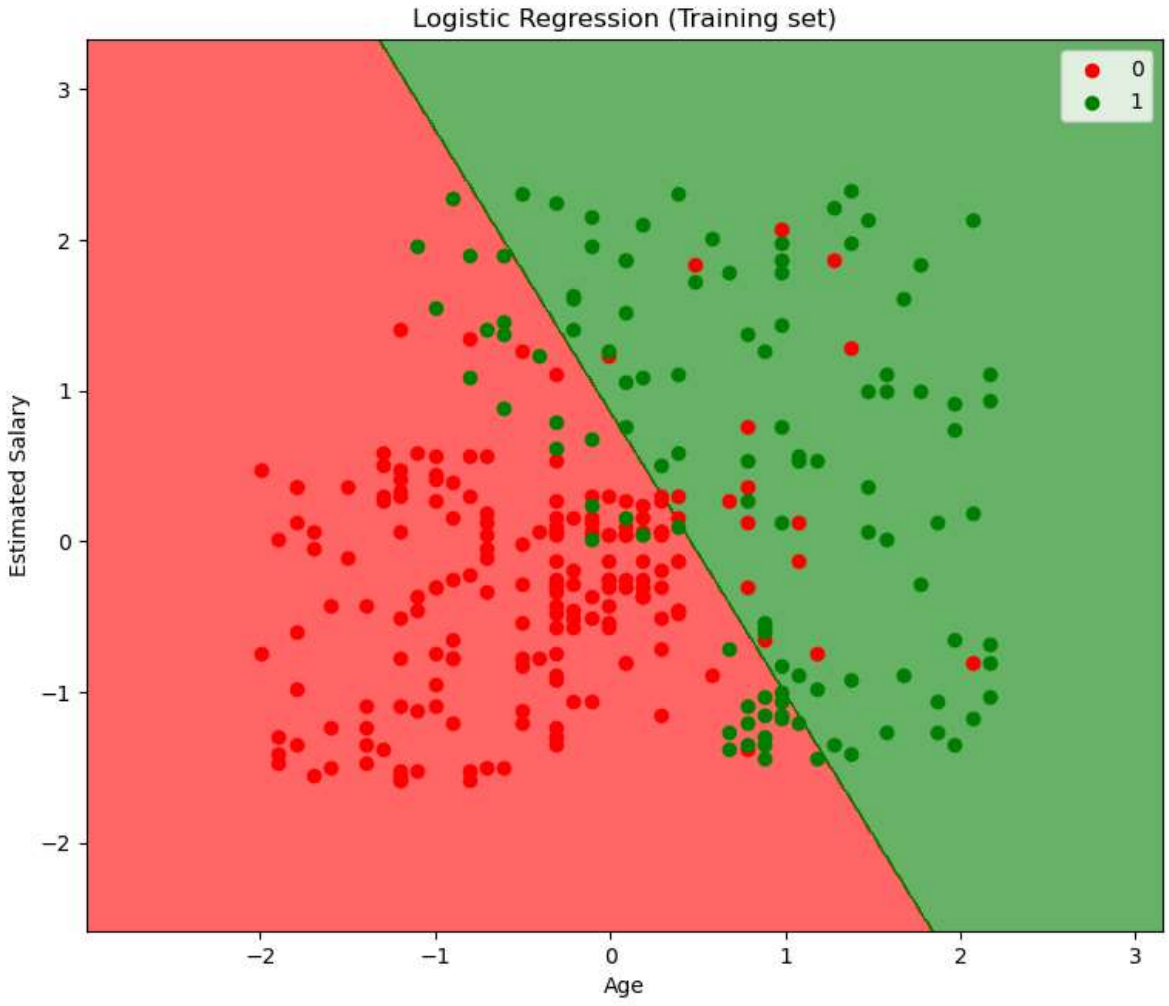


In [7]:
```
#confusion Matrix
```

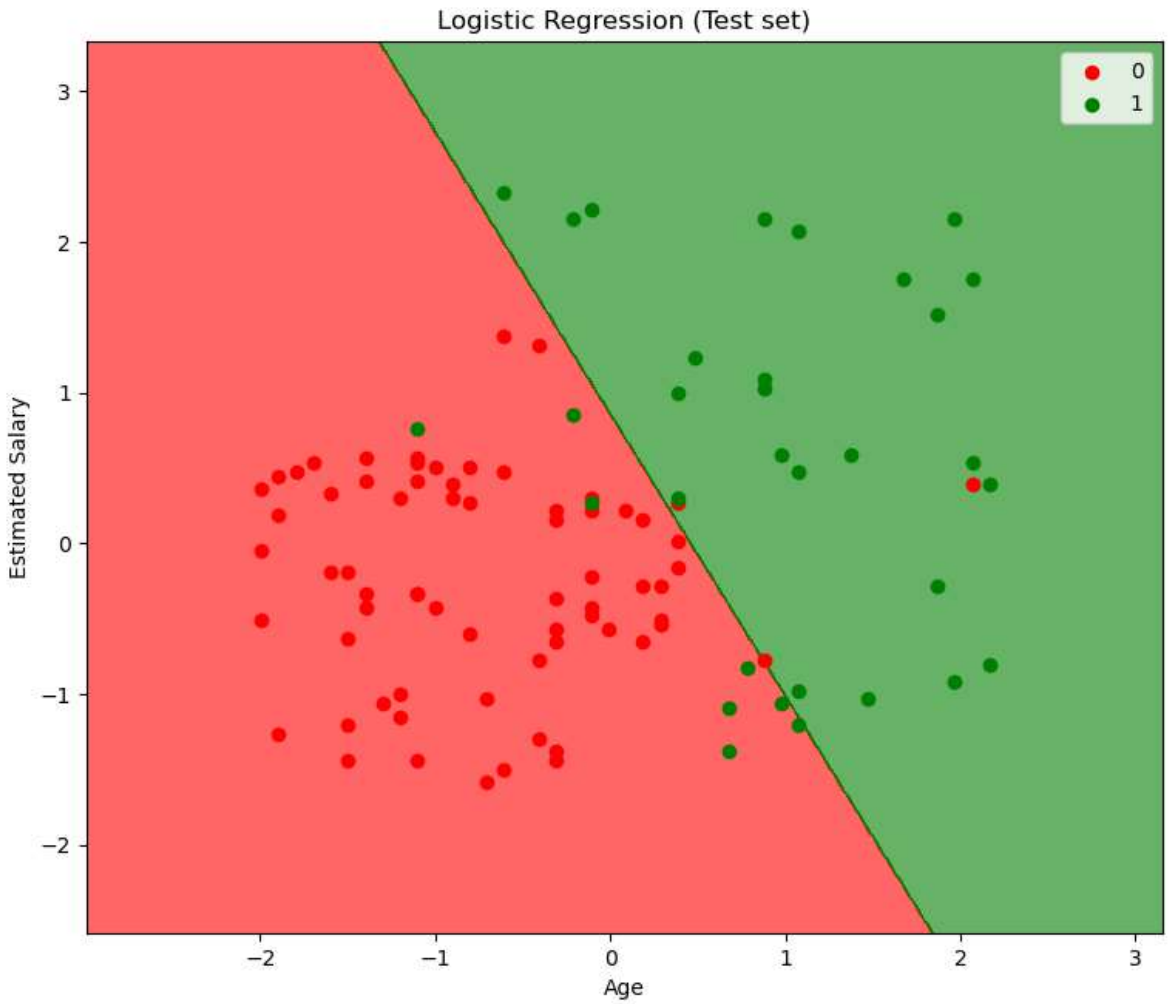
In [8]:
```
from sklearn.metrics import confusion_matrix
from sklearn.metrics import classification_report

cm = confusion_matrix(Y_test, predictions)
print(f'''Confusion matrix :\n
               | Positive Prediction\t| Negative Prediction
---------------+-----------------------+---------------------
Positive Class | True Positive (TP) {cm[0, 0]}\t| False Negative (FN)
{cm[0, 1]}
---------------+-----------------------+---------------------
Negative Class | False Positive (FP) {cm[1, 0]}\t| True Negative (TN)
{cm[1, 1]}\n\n''')

cm = classification_report(Y_test, predictions)
print('Classification report : \n', cm)
```

```
Confusion matrix :

               | Positive Prediction    | Negative Prediction
---------------+------------------------+---------------------
Positive Class | True Positive (TP) 65  | False Negative (FN) 3
---------------+------------------------+---------------------
Negative Class | False Positive (FP) 8  | True Negative (TN) 24


Classification report :
               precision    recall  f1-score   support

           0       0.89      0.96      0.92        68
           1       0.89      0.75      0.81        32

    accuracy                           0.89       100
   macro avg       0.89      0.85      0.87       100
weighted avg       0.89      0.89      0.89       100
```

In [9]:
```
# Visualizing the Training set results
from matplotlib.colors import ListedColormap
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.figure(figsize=(9, 7.5));
plt.contourf(X1, X2, lm.predict(np.array([X1.ravel(),
                                          X2.ravel()]).T).reshape(X1.shape),
             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],
                color = ListedColormap(('red', 'green'))(i), label = j);
plt.title('Logistic Regression (Training set)');
plt.xlabel('Age');
plt.ylabel('Estimated Salary');
plt.legend();
plt.show();
```



In [10]:
```
# Visualizing the Test set results
from matplotlib.colors import ListedColormap
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.figure(figsize=(9, 7.5));
plt.contourf(X1, X2, lm.predict(np.array([X1.ravel(),
                    X2.ravel()]).T).reshape(X1.shape),
         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],
      color = ListedColormap(('red', 'green'))(i), label = j);
plt.title('Logistic Regression (Test set)');
plt.xlabel('Age');
plt.ylabel('Estimated Salary');
plt.legend();
plt.show();
```



In [ ]: