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Implement logistic regression using Python/R to perform classification on Social_Network_Ads.csv dataset.

Import libraries and create alias for Pandas, Numpy

[ ]:

```python
import pandas as pd
import numpy as np
```

Import the Social_Media_Adv Dataset

[ ]:

```python
from google.colab import files
files.upload()
```

```
<IPython.core.display.HTML object>
```

```
Saving Social_Network_Ads.csv to Social_Network_Ads.csv
```

[ ]:

```
{'Social_Network_Ads.csv': b'Age,EstimatedSalary,Purchased\r\n19,19000,0\r\n35,2
0000,0\r\n26,43000,0\r\n27,57000,0\r\n19,76000,0\r\n27,58000,0\r\n27,84000,0\r\n
32,150000,1\r\n25,33000,0\r\n35,65000,0\r\n26,80000,0\r\n26,52000,0\r\n20,86000,
0\r\n32,18000,0\r\n18,82000,0\r\n29,80000,0\r\n47,25000,1\r\n45,26000,1\r\n46,28
000,1\r\n48,29000,1\r\n45,22000,1\r\n47,49000,1\r\n48,41000,1\r\n45,22000,1\r\n4
6,23000,1\r\n47,20000,1\r\n49,28000,1\r\n47,30000,1\r\n29,43000,0\r\n31,18000,0\
r\n31,74000,0\r\n27,137000,1\r\n21,16000,0\r\n28,44000,0\r\n27,90000,0\r\n35,270
00,0\r\n33,28000,0\r\n30,49000,0\r\n26,72000,0\r\n27,31000,0\r\n27,17000,0\r\n33
,51000,0\r\n35,108000,0\r\n30,15000,0\r\n28,84000,0\r\n23,20000,0\r\n25,79000,0\
r\n27,54000,0\r\n30,135000,1\r\n31,89000,0\r\n24,32000,0\r\n18,44000,0\r\n29,830
00,0\r\n35,23000,0\r\n27,58000,0\r\n24,55000,0\r\n23,48000,0\r\n28,79000,0\r\n22
,18000,0\r\n32,117000,0\r\n27,20000,0\r\n25,87000,0\r\n23,66000,0\r\n32,120000,1
\r\n59,83000,0\r\n24,58000,0\r\n24,19000,0\r\n23,82000,0\r\n22,63000,0\r\n31,680
00,0\r\n25,80000,0\r\n24,27000,0\r\n20,23000,0\r\n33,113000,0\r\n32,18000,0\r\n3
4,112000,1\r\n18,52000,0\r\n22,27000,0\r\n28,87000,0\r\n26,17000,0\r\n30,80000,0
\r\n39,42000,0\r\n20,49000,0\r\n35,88000,0\r\n30,62000,0\r\n31,118000,1\r\n24,55
000,0\r\n28,85000,0\r\n26,81000,0\r\n35,50000,0\r\n22,81000,0\r\n30,116000,0\r\n
26,15000,0\r\n29,28000,0\r\n29,83000,0\r\n35,44000,0\r\n35,25000,0\r\n28,123000,
1\r\n35,73000,0\r\n28,37000,0\r\n27,88000,0\r\n28,59000,0\r\n32,86000,0\r\n33,14
9000,1\r\n19,21000,0\r\n21,72000,0\r\n26,35000,0\r\n27,89000,0\r\n26,86000,0\r\n
38,80000,0\r\n39,71000,0\r\n37,71000,0\r\n38,61000,0\r\n37,55000,0\r\n42,80000,0
\r\n40,57000,0\r\n35,75000,0\r\n36,52000,0\r\n40,59000,0\r\n41,59000,0\r\n36,750
```

```
00,0\r\n37,72000,0\r\n40,75000,0\r\n35,53000,0\r\n41,51000,0\r\n39,61000,0\r\n42
,65000,0\r\n26,32000,0\r\n30,17000,0\r\n26,84000,0\r\n31,58000,0\r\n33,31000,0\r
\n30,87000,0\r\n21,68000,0\r\n28,55000,0\r\n23,63000,0\r\n20,82000,0\r\n30,10700
0,1\r\n28,59000,0\r\n19,25000,0\r\n19,85000,0\r\n18,68000,0\r\n35,59000,0\r\n30,
89000,0\r\n34,25000,0\r\n24,89000,0\r\n27,96000,1\r\n41,30000,0\r\n29,61000,0\r\
n20,74000,0\r\n26,15000,0\r\n41,45000,0\r\n31,76000,0\r\n36,50000,0\r\n40,47000,
0\r\n31,15000,0\r\n46,59000,0\r\n29,75000,0\r\n26,30000,0\r\n32,135000,1\r\n32,1
00000,1\r\n25,90000,0\r\n37,33000,0\r\n35,38000,0\r\n33,69000,0\r\n18,86000,0\r\
n22,55000,0\r\n35,71000,0\r\n29,148000,1\r\n29,47000,0\r\n21,88000,0\r\n34,11500
0,0\r\n26,118000,0\r\n34,43000,0\r\n34,72000,0\r\n23,28000,0\r\n35,47000,0\r\n25
,22000,0\r\n24,23000,0\r\n31,34000,0\r\n26,16000,0\r\n31,71000,0\r\n32,117000,1\
r\n33,43000,0\r\n33,60000,0\r\n31,66000,0\r\n20,82000,0\r\n33,41000,0\r\n35,7200
0,0\r\n28,32000,0\r\n24,84000,0\r\n19,26000,0\r\n29,43000,0\r\n19,70000,0\r\n28,
89000,0\r\n34,43000,0\r\n30,79000,0\r\n20,36000,0\r\n26,80000,0\r\n35,22000,0\r\
n35,39000,0\r\n49,74000,0\r\n39,134000,1\r\n41,71000,0\r\n58,101000,1\r\n47,4700
0,0\r\n55,130000,1\r\n52,114000,0\r\n40,142000,1\r\n46,22000,0\r\n48,96000,1\r\n
52,150000,1\r\n59,42000,0\r\n35,58000,0\r\n47,43000,0\r\n60,108000,1\r\n49,65000
,0\r\n40,78000,0\r\n46,96000,0\r\n59,143000,1\r\n41,80000,0\r\n35,91000,1\r\n37,
144000,1\r\n60,102000,1\r\n35,60000,0\r\n37,53000,0\r\n36,126000,1\r\n56,133000,
1\r\n40,72000,0\r\n42,80000,1\r\n35,147000,1\r\n39,42000,0\r\n40,107000,1\r\n49,
86000,1\r\n38,112000,0\r\n46,79000,1\r\n40,57000,0\r\n37,80000,0\r\n46,82000,0\r
\n53,143000,1\r\n42,149000,1\r\n38,59000,0\r\n50,88000,1\r\n56,104000,1\r\n41,72
000,0\r\n51,146000,1\r\n35,50000,0\r\n57,122000,1\r\n41,52000,0\r\n35,97000,1\r\
n44,39000,0\r\n37,52000,0\r\n48,134000,1\r\n37,146000,1\r\n50,44000,0\r\n52,9000
0,1\r\n41,72000,0\r\n40,57000,0\r\n58,95000,1\r\n45,131000,1\r\n35,77000,0\r\n36
,144000,1\r\n55,125000,1\r\n35,72000,0\r\n48,90000,1\r\n42,108000,1\r\n40,75000,
0\r\n37,74000,0\r\n47,144000,1\r\n40,61000,0\r\n43,133000,0\r\n59,76000,1\r\n60,
42000,1\r\n39,106000,1\r\n57,26000,1\r\n57,74000,1\r\n38,71000,0\r\n49,88000,1\r
\n52,38000,1\r\n50,36000,1\r\n59,88000,1\r\n35,61000,0\r\n37,70000,1\r\n52,21000
,1\r\n48,141000,0\r\n37,93000,1\r\n37,62000,0\r\n48,138000,1\r\n41,79000,0\r\n37
,78000,1\r\n39,134000,1\r\n49,89000,1\r\n55,39000,1\r\n37,77000,0\r\n35,57000,0\
r\n36,63000,0\r\n42,73000,1\r\n43,112000,1\r\n45,79000,0\r\n46,117000,1\r\n58,38
000,1\r\n48,74000,1\r\n37,137000,1\r\n37,79000,1\r\n40,60000,0\r\n42,54000,0\r\n
51,134000,0\r\n47,113000,1\r\n36,125000,1\r\n38,50000,0\r\n42,70000,0\r\n39,9600
0,1\r\n38,50000,0\r\n49,141000,1\r\n39,79000,0\r\n39,75000,1\r\n54,104000,1\r\n3
5,55000,0\r\n45,32000,1\r\n36,60000,0\r\n52,138000,1\r\n53,82000,1\r\n41,52000,0
\r\n48,30000,1\r\n48,131000,1\r\n41,60000,0\r\n41,72000,0\r\n42,75000,0\r\n36,11
8000,1\r\n47,107000,1\r\n38,51000,0\r\n48,119000,1\r\n42,65000,0\r\n40,65000,0\r
\n57,60000,1\r\n36,54000,0\r\n58,144000,1\r\n35,79000,0\r\n38,55000,0\r\n39,1220
00,1\r\n53,104000,1\r\n35,75000,0\r\n38,65000,0\r\n47,51000,1\r\n47,105000,1\r\n
41,63000,0\r\n53,72000,1\r\n54,108000,1\r\n39,77000,0\r\n38,61000,0\r\n38,113000
,1\r\n37,75000,0\r\n42,90000,1\r\n37,57000,0\r\n36,99000,1\r\n60,34000,1\r\n54,7
0000,1\r\n41,72000,0\r\n40,71000,1\r\n42,54000,0\r\n43,129000,1\r\n53,34000,1\r\
n47,50000,1\r\n42,79000,0\r\n42,104000,1\r\n59,29000,1\r\n58,47000,1\r\n46,88000
,1\r\n38,71000,0\r\n54,26000,1\r\n60,46000,1\r\n60,83000,1\r\n39,73000,0\r\n59,1
30000,1\r\n37,80000,0\r\n46,32000,1\r\n46,74000,0\r\n42,53000,0\r\n41,87000,1\r\
n58,23000,1\r\n42,64000,0\r\n48,33000,1\r\n44,139000,1\r\n49,28000,1\r\n57,33000
```

```
,1\r\n56,60000,1\r\n49,39000,1\r\n39,71000,0\r\n47,34000,1\r\n48,35000,1\r\n48,3
3000,1\r\n47,23000,1\r\n45,45000,1\r\n60,42000,1\r\n39,59000,0\r\n46,41000,1\r\n
51,23000,1\r\n50,20000,1\r\n36,33000,0\r\n49,36000,1'}
```

Initialize the data frame

```
[ ]: df=pd.read_csv("/content/Social_Network_Ads.csv")
```

Perform Data Preprocessing

```
[ ]: df.head()
```

```
[ ]:    Age  EstimatedSalary  Purchased
     0   19            19000          0
     1   35            20000          0
     2   26            43000          0
     3   27            57000          0
     4   19            76000          0
```

```
[ ]: df.describe()
```

```
[ ]:               Age  EstimatedSalary   Purchased
     count  400.000000       400.000000  400.000000
     mean    37.655000     69742.500000    0.357500
     std     10.482877     34096.960282    0.479864
     min     18.000000     15000.000000    0.000000
     25%     29.750000     43000.000000    0.000000
     50%     37.000000     70000.000000    0.000000
     75%     46.000000     88000.000000    1.000000
     max     60.000000    150000.000000    1.000000
```

```
[ ]: df.isnull().sum()
```

```
[ ]: Age                0
     EstimatedSalary    0
     Purchased          0
     dtype: int64
```

```
[ ]: df.info()
```

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

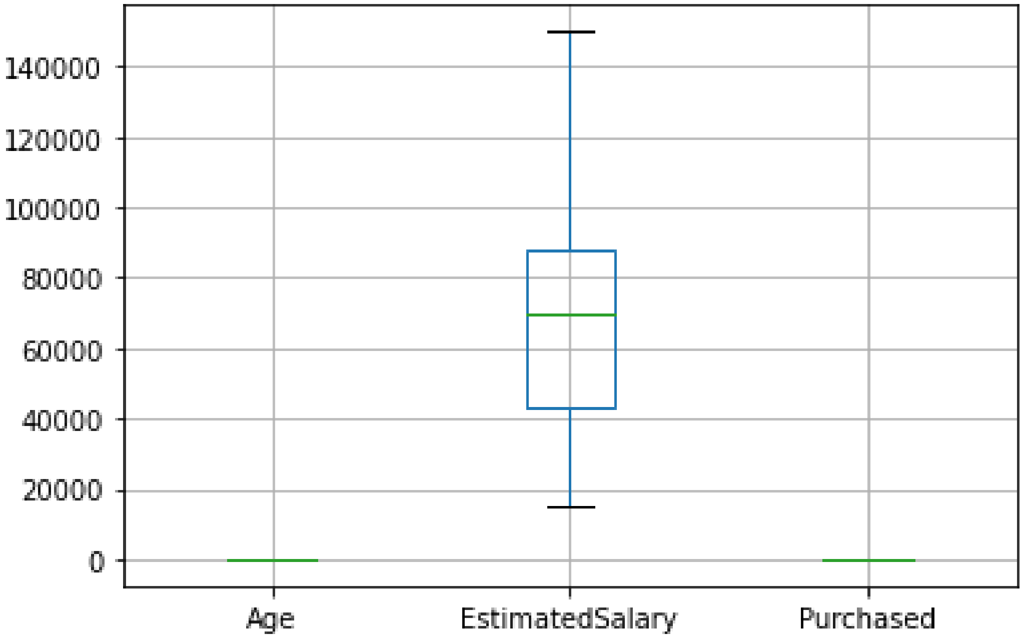
```
dtypes: int64(3)
memory usage: 9.5 KB
```

Import Seaborn and Matplotlib

```
[ ]: import seaborn as sns
     import matplotlib.pyplot as plt
```

```
[ ]: df.boxplot()
```

```
[ ]: <Axes: >
```



```
[ ]: X = df.drop(['Purchased'], axis = 1)
     Y = df['Purchased']
```

Use Logistic regression(Train the Machine) to Create Model

```
[ ]: from sklearn.model_selection import train_test_split
     xtrain, xtest, ytrain, ytest = train_test_split(X, Y, test_size =0.
       ↪2,random_state = 0)
```

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

```
[ ]: logreg = LogisticRegression()
```

```
[ ]: logreg.fit(xtrain,ytrain)
[ ]: LogisticRegression()
```

Predict the y_pred for all values of and test_x

```
[ ]: y_pred=logreg.predict(xtest)
```

```
[ ]: print(xtrain)
     print("------------\n")
     print(xtest)
     print("------------\n")
     print(ytrain)
     print("------------\n")
     print(ytest)
     print("------------\n")
     print(y_pred)
```

```
     Age  EstimatedSalary
336   58           144000
64    59            83000
55    24            55000
106   26            35000
300   58            38000
..   …              …
323   48            30000
192   29            43000
117   36            52000
47    27            54000
172   26           118000

[320 rows x 2 columns]
------------

     Age  EstimatedSalary
132   30            87000
309   38            50000
341   35            75000
196   30            79000
246   35            50000
..   …              …
14    18            82000
363   42            79000
304   40            60000
361   53            34000
329   47           107000

[80 rows x 2 columns]
------------
```

```
336    1
64     0
55     0
106    0
300    1
      ..
323    1
192    0
117    0
47     0
172    0
Name: Purchased, Length: 320, dtype: int64
------------

132    0
309    0
341    0
196    0
246    0
      ..
14     0
363    0
304    0
361    1
329    1
Name: Purchased, Length: 80, dtype: int64
------------

[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0]
```

Find the Following Parameters for Logistic Regression on Social_Networking_Ads dataset: 1. Classification Report 2. Accuracy Score 3. Confusion Matrix 4. Error Rate 5. Precision 6. Recall

[ ]:

```
from sklearn.metrics import␣
 ↪precision_score,confusion_matrix,accuracy_score,recall_score,␣
 ↪classification_report
```

Confusion Matrix

[ ]:

```
cm= confusion_matrix(ytest, y_pred)
cm
```

[ ]:

```
array([[58,  0],
       [22,  0]])
```

accuracy_score

```
[ ]: print ("Accuracy : ", accuracy_score(ytest, y_pred))
```

```
Accuracy :  0.725
```

Precision

```
[ ]: ps = precision_score(ytest, y_pred)
```

```
/usr/local/lib/python3.9/dist-packages/sklearn/metrics/_classification.py:1344:
UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 due to no
predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

```
[ ]: ps
```

```
[ ]: 0.0
```

Recall score

```
[ ]: rs = recall_score(ytest, y_pred)
```

```
[ ]: rs
```

```
[ ]: 0.0
```

*Error Rate**

```
[ ]: error_rate = 1- accuracy_score(ytest, y_pred)
```

```
[ ]: error_rate
```

```
[ ]: 0.275
```

Classification Report

```
[ ]: print("classification report: ",classification_report(ytest, y_pred))
```

```
classification report:                precision    recall  f1-score   support

           0       0.72      1.00      0.84        58
           1       0.00      0.00      0.00        22

    accuracy                           0.73        80
   macro avg       0.36      0.50      0.42        80
weighted avg       0.53      0.72      0.61        80

/usr/local/lib/python3.9/dist-packages/sklearn/metrics/_classification.py:1344:
UndefinedMetricWarning: Precision and F-score are ill-defined and being set to
0.0 in labels with no predicted samples. Use `zero_division` parameter to
```

```
control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.9/dist-packages/sklearn/metrics/_classification.py:1344:
UndefinedMetricWarning: Precision and F-score are ill-defined and being set to
0.0 in labels with no predicted samples. Use `zero_division` parameter to
control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.9/dist-packages/sklearn/metrics/_classification.py:1344:
UndefinedMetricWarning: Precision and F-score are ill-defined and being set to
0.0 in labels with no predicted samples. Use `zero_division` parameter to
control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

[ ]: