Service Cancellation Predictor

Preprocessing

we use:

from matplotlib. Figure import Figure

import matplotlib. pyplot as plt **To**

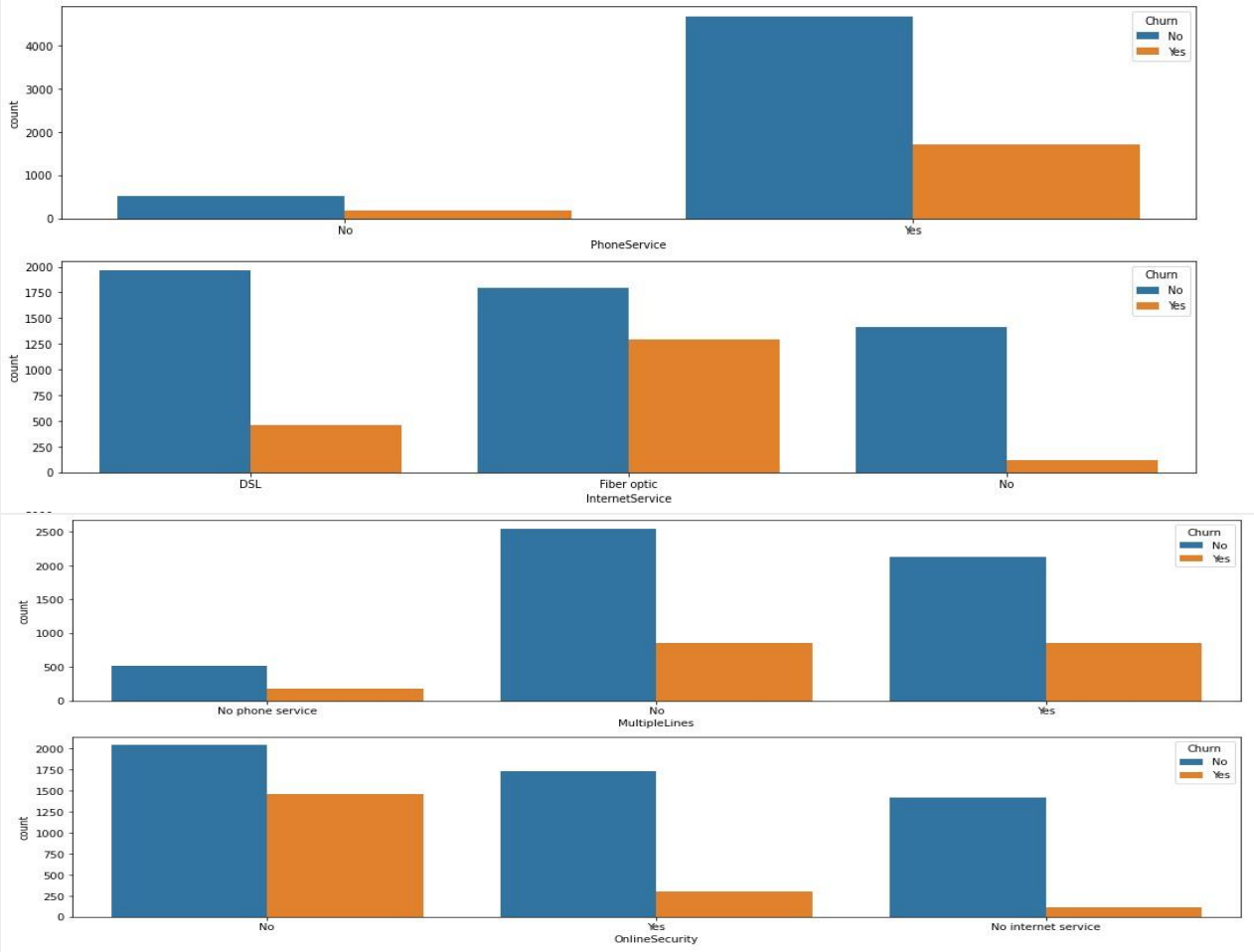
show the plot and the Figure import

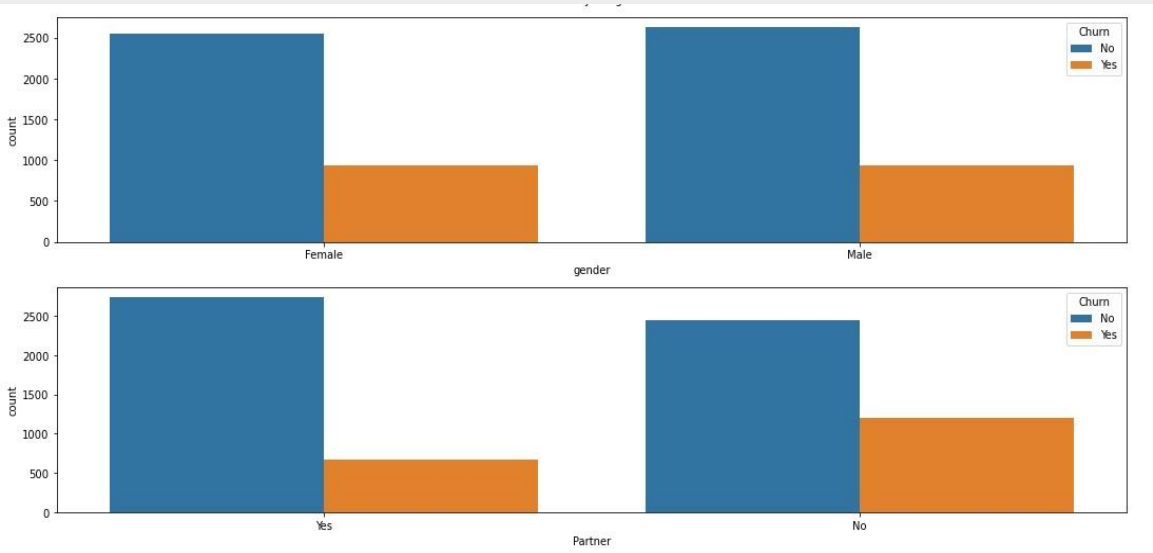
seaborn as sns

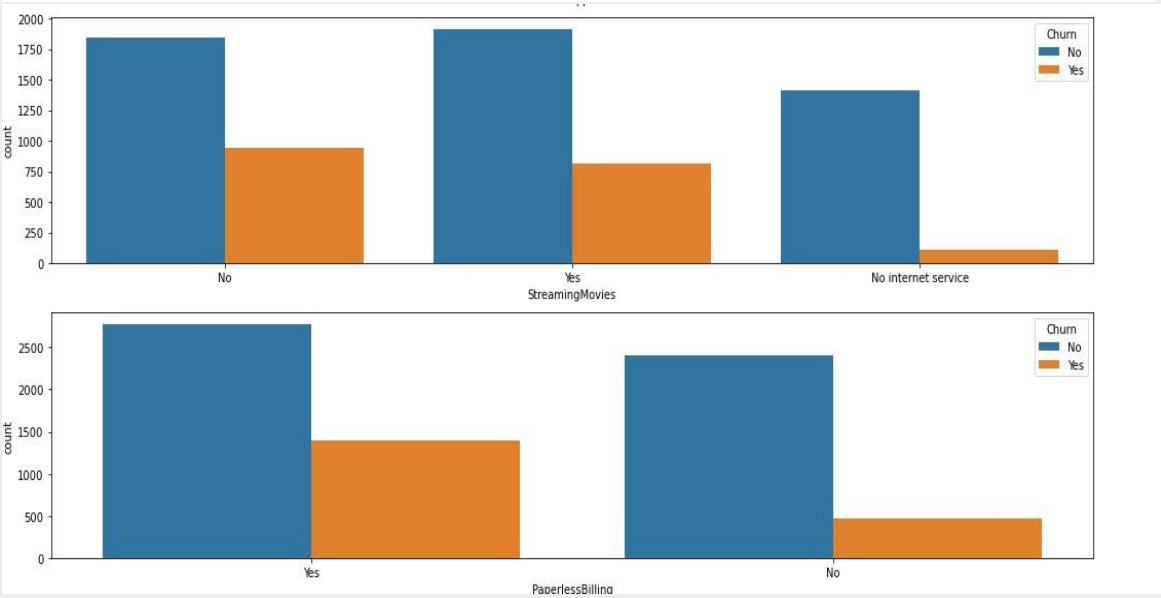
Seaborn based on matplotlib. It provides a high-level interface for drawing attractive and informative statistical graphics.

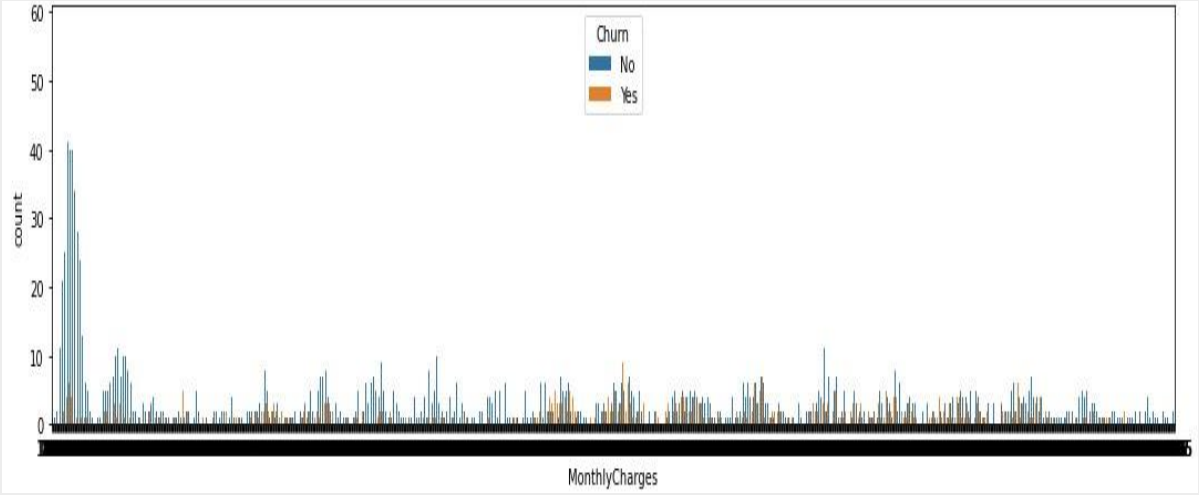
Sns.countplot (for each independent variables , dependent variables "churn", data=our data set, ax= "Axes object to draw the plot onto")

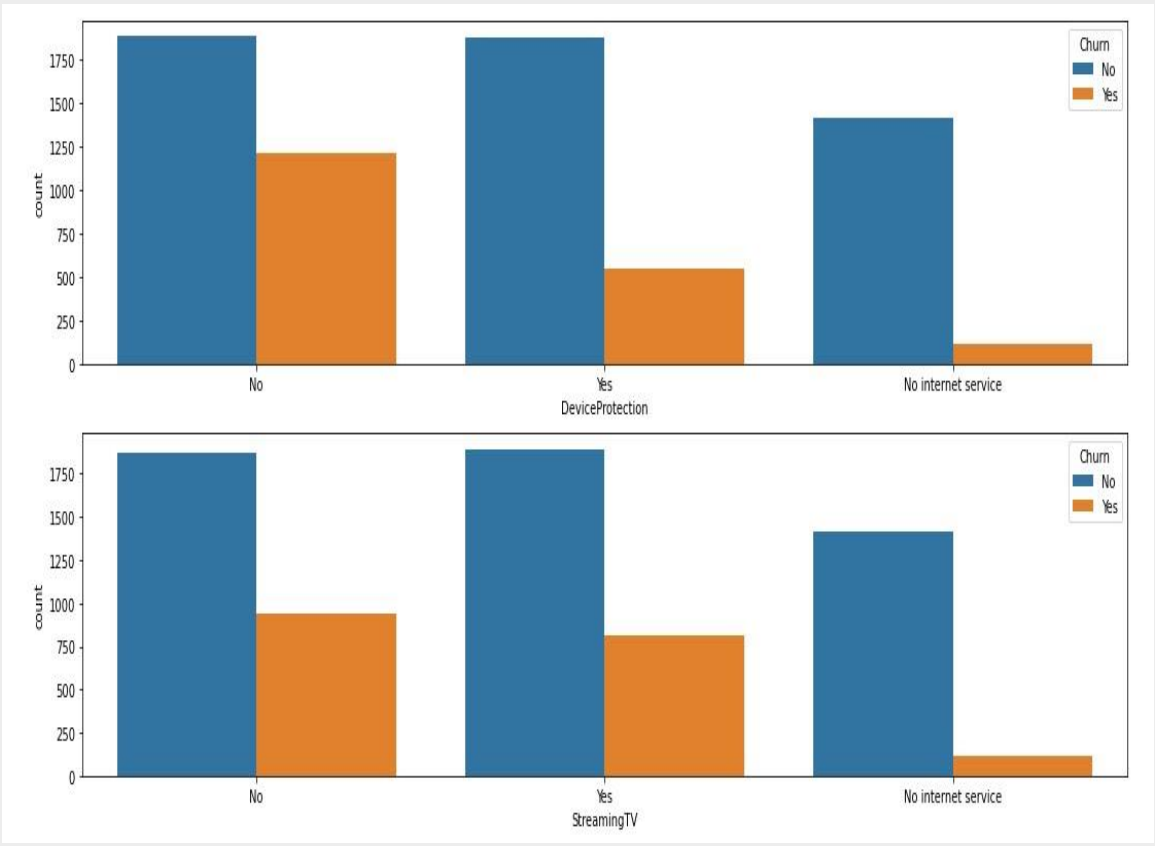
Put all the plots in function so we can call it where we want

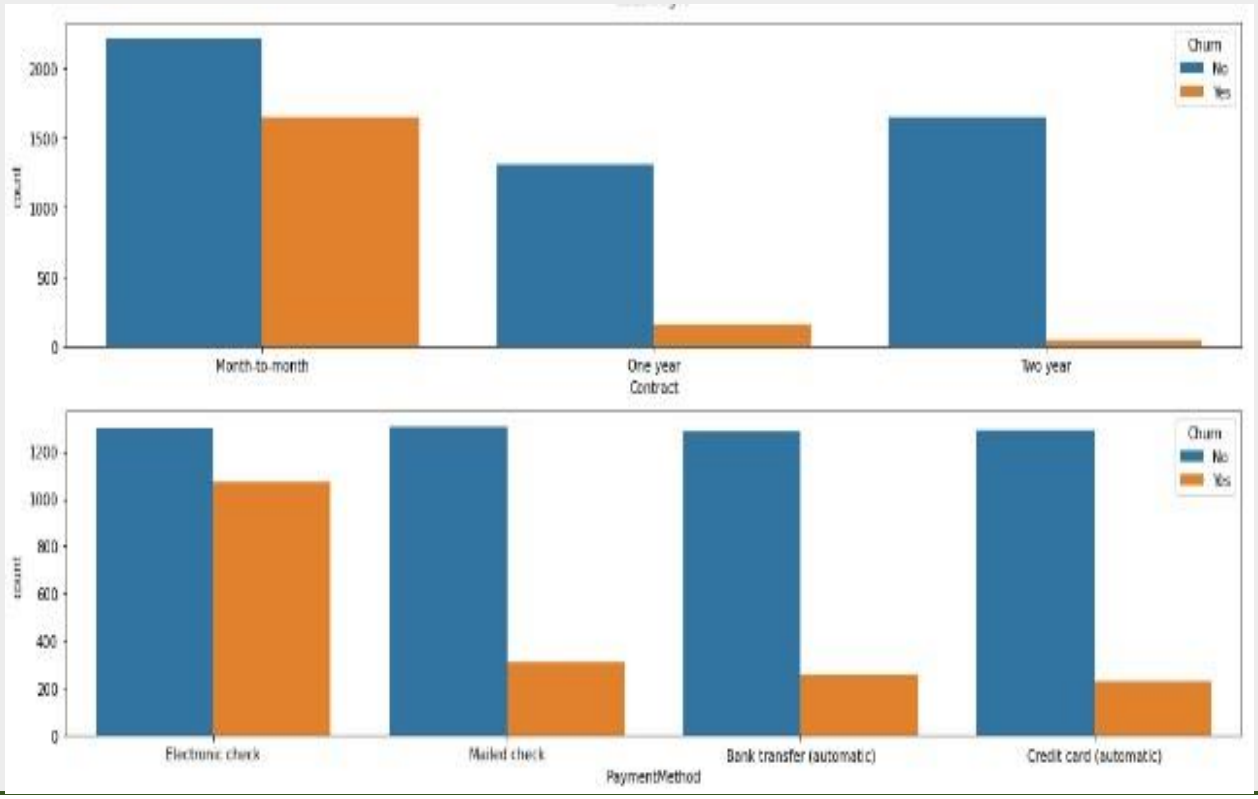

Churn
No
Yes
count
PhoneService
No
Yes
InternetService
DSL
Fiber optic
No
MultipleLines
No phone service
No
Yes
OnlineSecurity
No
Yes
No internet service

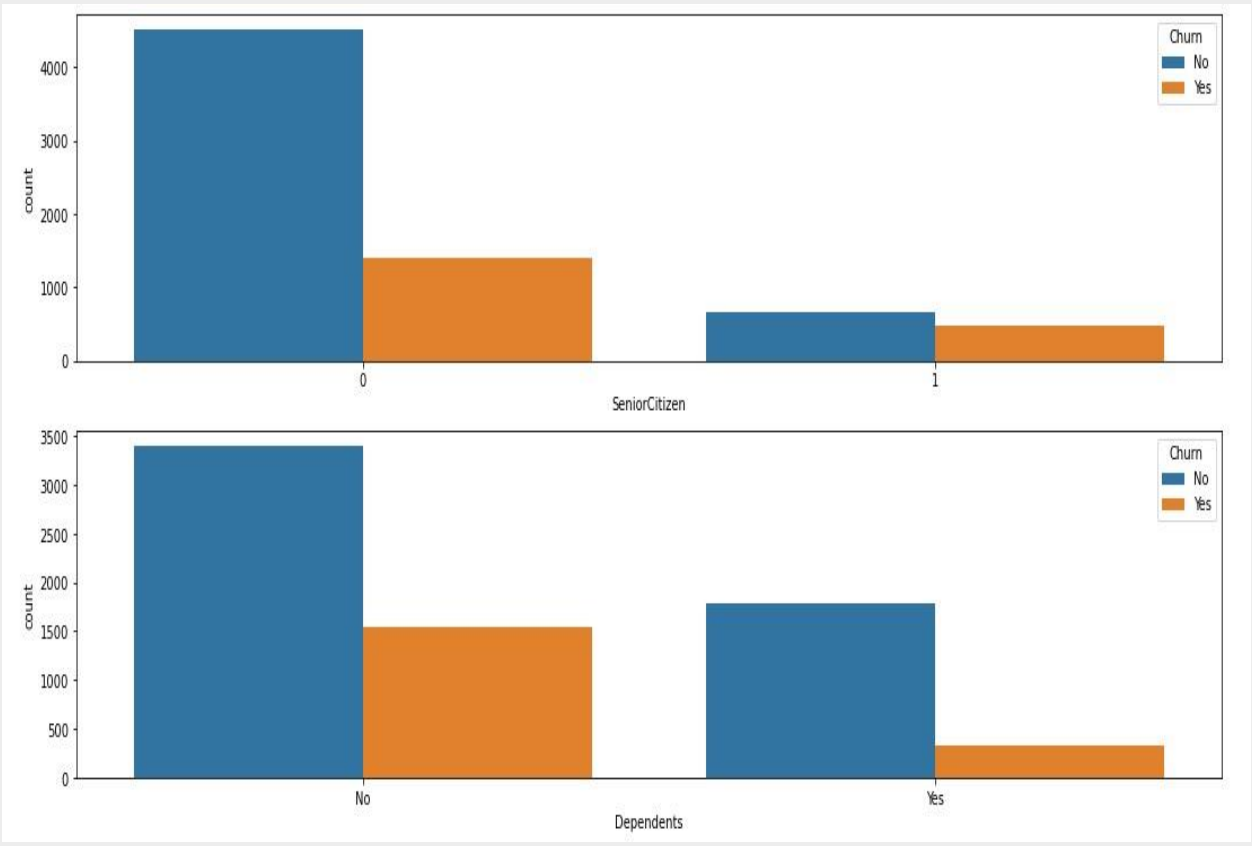

Churn
No
Yes
count
2500
2000
1500
1000
500
0
Female
Male
gender
Churn
No
Yes
count
2500
2000
1500
1000
500
0
Yes
No
Partner

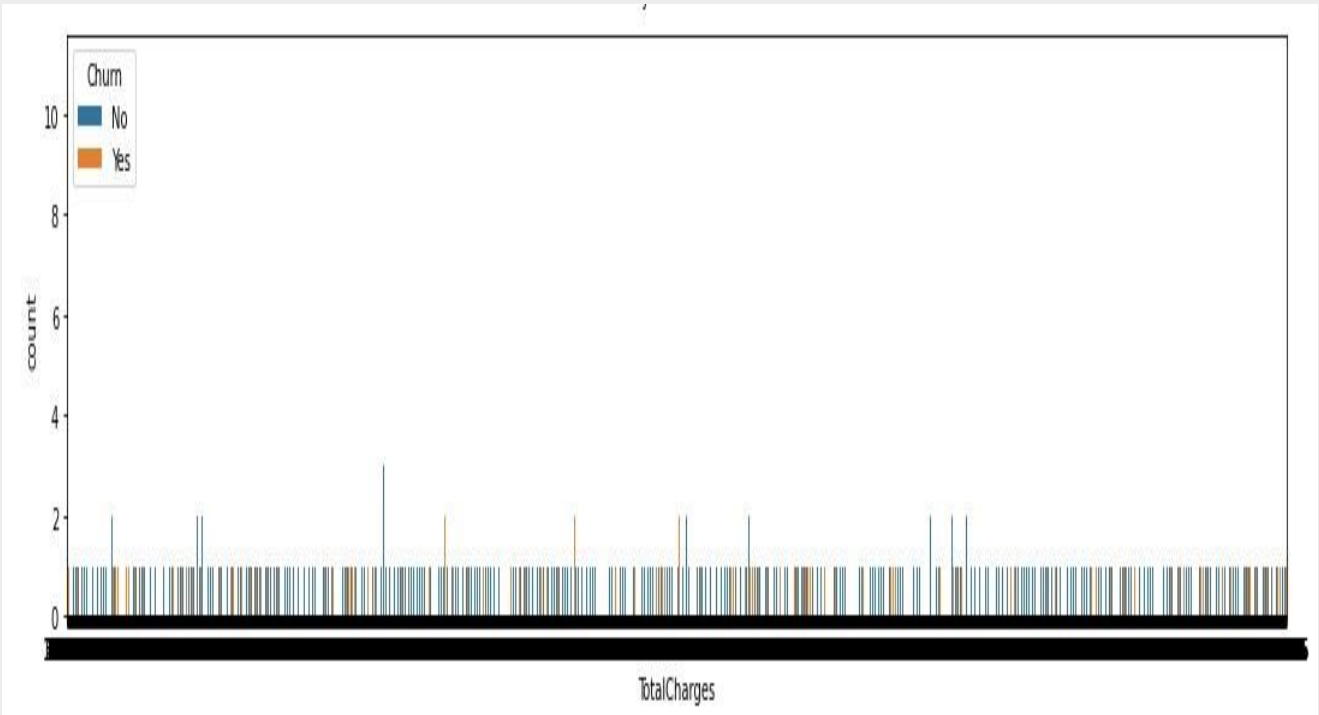

Churn
No
Yes
count
2000
1750
1500
1250
1000
750
500
250
0
No
Yes
No internet service
StreamingMovies
Churn
No
Yes
count
2500
2000
1500
1000
500
0
Yes
No
PaperlessBilling


Churn
No
Yes
count
60
50
40
30
20
10
0
MonthlyCharges


Churn
No
Yes
count
0
250
500
750
1000
1250
1500
1750
No
Yes
No internet service
DeviceProtection
Churn
No
Yes
count
0
250
500
750
1000
1250
1500
1750
No
Yes
No internet service
StreamingTV


Churn
No
Yes
count
0
500
1000
1500
2000
Month-to-month
One year
Two year
Contract
Churn
No
Yes
count
0
200
400
600
800
1000
1200
Electronic check
Mailed check
Bank transfer (automatic)
Credit card (automatic)
PaymentMethod


Churn
No
Yes
count
4000
3000
2000
1000
0
0
1
SeniorCitizen
3500
2500
1500
500
No
Yes
Dependents


Churn
No
Yes
count
10
8
6
4
2
0
TotalCharges

Data Cleaning

To do that we have 4 steps

*** create a function to take our data to do cleaning and return it after cleaning**

****First step:**

```
import numpy as np
from sklearn import preprocessing as pp

#change datatype of columns and convert the categorical to numeric
def cleaning (data):

    label_encoder=pp.LabelEncoder()
    data['Partner']= label_encoder.fit_transform(data['Partner'])

    data["gender"]= label_encoder.fit_transform(data['gender'])

    data["Dependents"]= label_encoder.fit_transform(data['Dependents'])
    data["InternetService"]= label_encoder.fit_transform(data['InternetService'])
    data["OnlineSecurity"]= label_encoder.fit_transform(data['OnlineSecurity'])
    data["Churn"]= label_encoder.fit_transform(data['Churn'])
    data["MultipleLines"]= label_encoder.fit_transform(data['MultipleLines'])
    data["OnlineSecurity"]= label_encoder.fit_transform(data['OnlineSecurity'])
    data["OnlineBackup"]= label_encoder.fit_transform(data['OnlineBackup'])
    data["DeviceProtection"]= label_encoder.fit_transform(data['DeviceProtection'])
    data["TechSupport"]= label_encoder.fit_transform(data['TechSupport'])
    data["StreamingTV"]= label_encoder.fit_transform(data['StreamingTV'])
    data["StreamingMovies"]= label_encoder.fit_transform(data['StreamingMovies'])
    data["InternetService"]= label_encoder.fit_transform(data['InternetService'])
    data["Contract"]= label_encoder.fit_transform(data['Contract'])
    data["PaymentMethod"]= label_encoder.fit_transform(data['PaymentMethod'])
    data["PaperlessBilling"]= label_encoder.fit_transform(data['PaperlessBilling'])
```

- **We change our data to numeric by use (label_Encoder : to change yes &no &… To 0 & 1&…)&(fit_transform : to change strings to numeric by alphabetical order)**

**Second step:

```
#convert the empty cells to nan , changing data type and fill all nan values by using the mean of the column

data["TotalCharges"] = data["TotalCharges"].replace(" " , np.nan)
data["TotalCharges"]=data["TotalCharges"].astype('float64')
data["TotalCharges"]=data["TotalCharges"].fillna(value= data["TotalCharges"].mean())
```

- **We have an empty cells in Totalcharges column so we handling that by turn empty cells to Null and replace Null to the mean of data[TotalCharges]**
- **We change data type of column form object to float64 to be numeric**

**Third step: “Data Scalling”

```
#normalization of data

    data_scaler= pp.MinMaxScaler(feature_range=(0 , 1))
    TotalCharges_array=data[["TotalCharges"]]
    TotalCharges = data_scaler.fit_transform(TotalCharges_array)
    data["TotalCharges"] = TotalCharges

    MonthlyCharges_array=data[["MonthlyCharges"]]
    MonthlyCharges = data_scaler.fit_transform(MonthlyCharges_array)
    data["MonthlyCharges"] = MonthlyCharges

    tenure_array=data[["tenure"]]
    tenure = data_scaler.fit_transform(tenure_array)
    data["tenure"] = tenure
```

- **We have 3 columns (TotalCharges , MonthlyCharges,Tenure) numeric but its very heigh and different so that we need to normalize this column to predict correct**

- **We make min &max range to numbers between (0,1) by using MinMaxScaler and puting it in data_scaler**
- **Puting data of column in array in order to have the appility to make scaling**
- **Makeing scaling in array and fiting it by fit_tranform and puting it in object**
- **Put that object after makeing scaling in its column in data**

**Forth step:

```
#drop the unwanted features

data = data.drop('gender', axis=1)
data = data.drop('PhoneService', axis=1)
data = data.drop('MultipleLines', axis=1)

print ('inforamtion: ')
print (data.info())
print ('description: ')
print (data.describe())

return data
```

- **After cleaning and pre-processing we will drop unwanted features that doesn't affect when we predict (gender ,Phone Service ,Multiple lines)**
- **print information to see our data types and number of Nulls**
- **print data description to see our first 5 rows information to see data after cleaning and number of rows and columns.**

Data after Cleaning

```
Data columns (total 17 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   SeniorCitizen      7043 non-null   int64
 1   Partner            7043 non-null   int32
 2   Dependents         7043 non-null   int32
 3   tenure             7043 non-null   float64
 4   InternetService    7043 non-null   int64
 5   OnlineSecurity     7043 non-null   int64
 6   OnlineBackup       7043 non-null   int32
 7   DeviceProtection   7043 non-null   int32
 8   TechSupport        7043 non-null   int32
 9   StreamingTV        7043 non-null   int32
 10  StreamingMovies    7043 non-null   int32
 11  Contract           7043 non-null   int32
 12  PaperlessBilling   7043 non-null   int32
 13  PaymentMethod      7043 non-null   int32
 14  MonthlyCharges     7043 non-null   float64
 15  TotalCharges       7043 non-null   float64
 16  Churn              7043 non-null   int32
dtypes: float64(3), int32(11), int64(3)
```

Algorithms

Logistic Regression

For train data:

- We import from sklearn. linear_model import LogisticRegression.
- We made function to train data take two parameters x_train and y_train and return LR (object of LogisticRegression class).

```
def trainRegression ( x_train , y_train ):
```

-

For module implementation:

- **We import statsmodels.api as sm to print the result summary.**

```
# module implementation :
logit_model = sm.Logit( y_train , x_train )
result = logit_model.fit()
print(result.summary2())
```

```
                          Results: Logit
==================================================================
Model:                  Logit              Pseudo R-squared: 0.275
Dependent Variable:     Churn              AIC:              4743.8587
Date:                   2022-05-21 11:46   BIC:              4850.0439
No. Observations:       5634               Log-Likelihood:   -2355.9
Df Model:               15                 LL-Null:          -3249.5
Df Residuals:           5618               LLR p-value:      0.0000
Converged:              1.0000             Scale:            1.0000
No. Iterations:         8.0000
------------------------------------------------------------------
                   Coef.  Std.Err.     z      P>|z|   [0.025  0.975]
------------------------------------------------------------------
SeniorCitizen      0.3217   0.0935   3.4390 0.0006  0.1383  0.5050
Partner           -0.0456   0.0859  -0.5302 0.5960 -0.2140  0.1229
Dependents        -0.1843   0.0982  -1.8763 0.0606 -0.3769  0.0082
tenure            -4.5932   0.4183 -10.9803 0.0000 -5.4131 -3.7733
InternetService   -0.0486   0.0586  -0.8287 0.4073 -0.1634  0.0663
OnlineSecurity    -0.2913   0.0454  -6.4104 0.0000 -0.3803 -0.2022
OnlineBackup      -0.1842   0.0420  -4.3804 0.0000 -0.2666 -0.1018
DeviceProtection  -0.0965   0.0434  -2.2241 0.0261 -0.1815 -0.0115
TechSupport       -0.3361   0.0464  -7.2443 0.0000 -0.4271 -0.2452
StreamingTV        0.0178   0.0456   0.3906 0.6961 -0.0715  0.1072
StreamingMovies    0.0234   0.0454   0.5146 0.6068 -0.0656  0.1123
Contract          -0.7802   0.0859  -9.0780 0.0000 -0.9486 -0.6117
PaperlessBilling   0.3443   0.0800   4.3049 0.0000  0.1875  0.5010
PaymentMethod     -0.0569   0.0323  -1.7619 0.0781 -0.1201  0.0064
MonthlyCharges     1.2856   0.1726   7.4467 0.0000  0.9473  1.6240
TotalCharges       3.6520   0.5657   6.4555 0.0000  2.5432  4.7608
==================================================================
```

doing an object form Logistic Regression class so it can be used for train data.

```
LR = LogisticRegression()
```

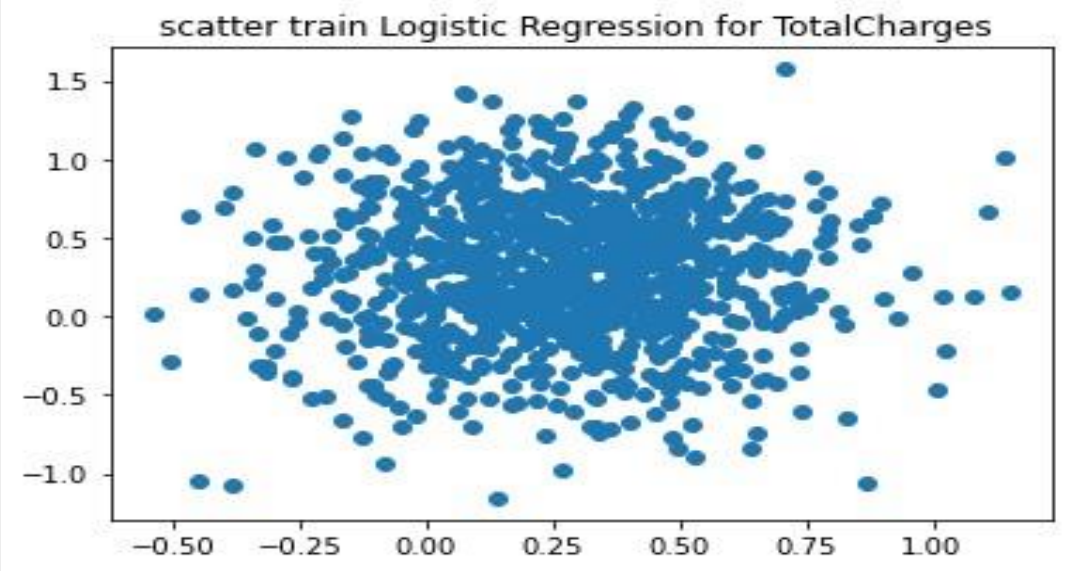
- we use from sklearn. metrics import accuracy_score to calculate accuracy.
- We use fit() function to train data.

```
#train data
LR.fit(x_train , y_train)
prediction= LR.predict(x_train)
ac_logisticregression=accuracy_score(y_train,prediction)
print("LogisticRegression train accuracy: ",ac_logisticregression)
```

**Logistic Regression train accuracy: 0.8004969826056088

For data scatter:

- Scatter train between Total Charges and churn:



- And in the end, we return LR (object of LogisticRegression class).

For test data:

- We made function to test data take three parameters x_test, y_test and LR (object of LogisticRegression class made fit () for the data) .

```
def testRegression( LR, x_test , y_test ):
```

- We use predict () function to predict the target then calculate the accuracy.

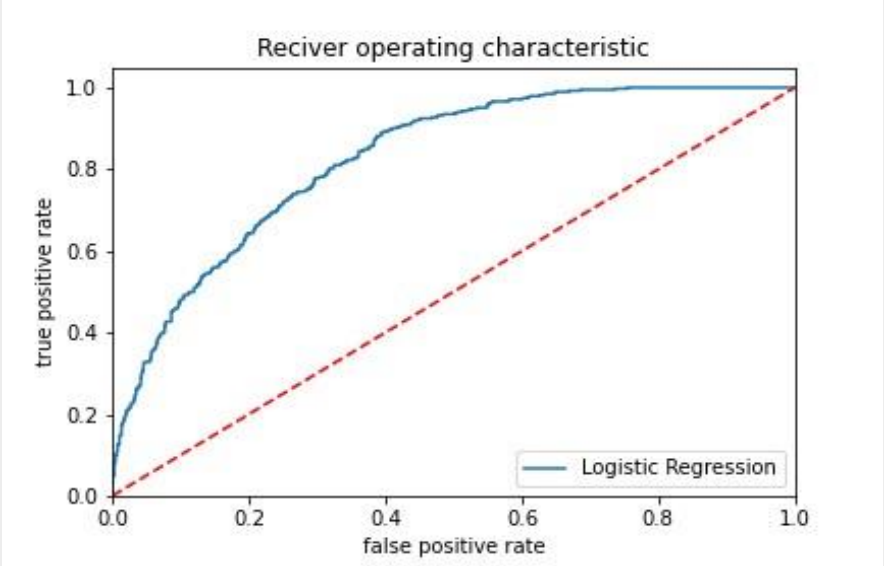
```
#predict the data :
pre = LR.predict(x_test)
#calculate the accuracy :
ac_logisticregression=accuracy_score(y_test,pre)
print("LogisticRegression test accuracy: ",ac_logisticregression)
```

For module implementation:

- We use from sklearn. metrics import roc_curve to calculate the logistic curve.

```
#model evaluation :
yy = y_test.squeeze()
roc = roc_auc_score(y_test, pre)
pre = pre.reshape(1, -1)
fpr , tpr , holds = roc_curve(yy, LR.predict_proba(x_test)[:,1])
plt.Figure()
plt.plot(fpr , tpr , label = 'Logistic Regression' % roc)
plt.plot([0,1] , [0,1] , 'r--')
plt.xlim([0.0 , 1.0])
plt.ylim([0.0,1.05])
plt.xlabel('false positive rate')
plt.ylabel('true positive rate')
plt.title("Reciver operating characteristic")
plt.legend(loc = 'lower right')
plt.savefig('Log_ROC')
plt.show()
```

- **We use import matplotlib. Pyplot as plt**



****Logistic Regression test accuracy: 0.8012775017743O8**

And in the end, we return LR (object of LogisticRegression class).

For predict data:

- We made function to predict data take two parameter data (1D array) and LR.

```
def predictRegression(LR , data):
```

```
xtest1=data
xtest1 = xtest1.reshape(1, -1)
ytest1=LR.predict(xtest1)
e = "yes"
if ytest1 == 0:
    e = "no"
print('Logistic Regression predicted Churn is ' + str(int(ytest1[0])) + "  for  "+ e )
```

We convert the 1D array to 2D array using reshape () function.

SVM

We use: from sklearn.svm

import SVC

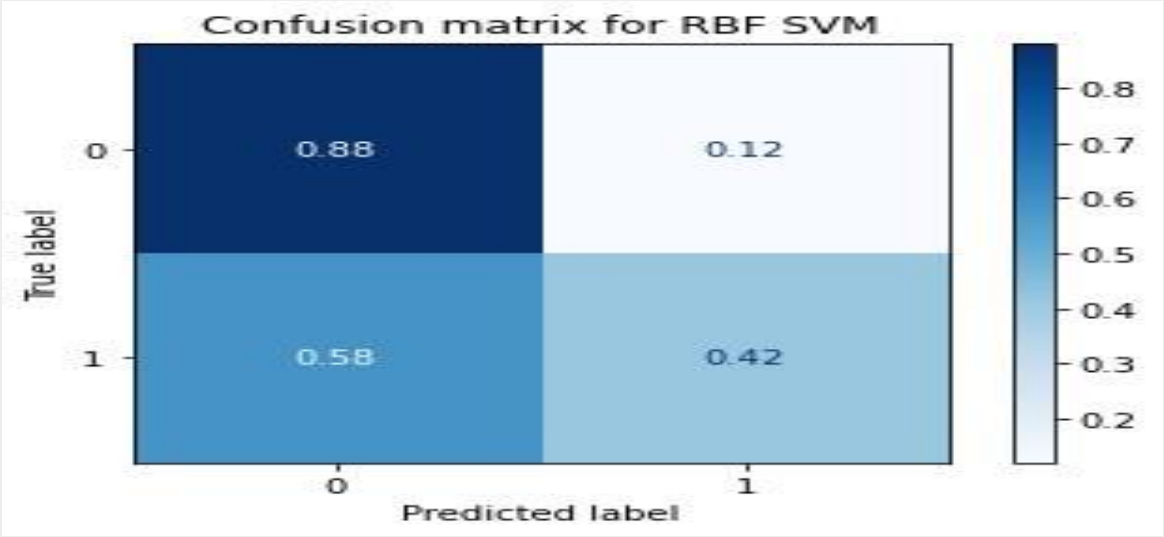
from sklearn. metrics import classification_report for example — **svm_test_report:**

```
Report:
              precision    recall  f1-score   support

           0       0.92      0.98      0.95      1066
           1       0.93      0.73      0.81       343

    accuracy                           0.92      1409
   macro avg       0.92      0.85      0.88      1409
weighted avg       0.92      0.92      0.92      1409
```

from matplotlib import pyplot as plt from sklearn. metrics import plot_confusion_matrix for confusion_matrix:



from sklearn. metrics import accuracy_score To show accuracy.

doing an object form svc so it can be used for train data.

```
SV = SVC(kernel='rbf', gamma=1.00)
```

For function train and test:

Doing fitting for (x_train, y_train for train), doing predict for (x_train for train) and (x_test for test) and finally calculate accuracy for each of them

SVM Accuracy for train: 0.8757543485977991.

SVM Accuracy for test: 0.7665010645848119.

And in the end of the train function, we return SV(object of SVC class)

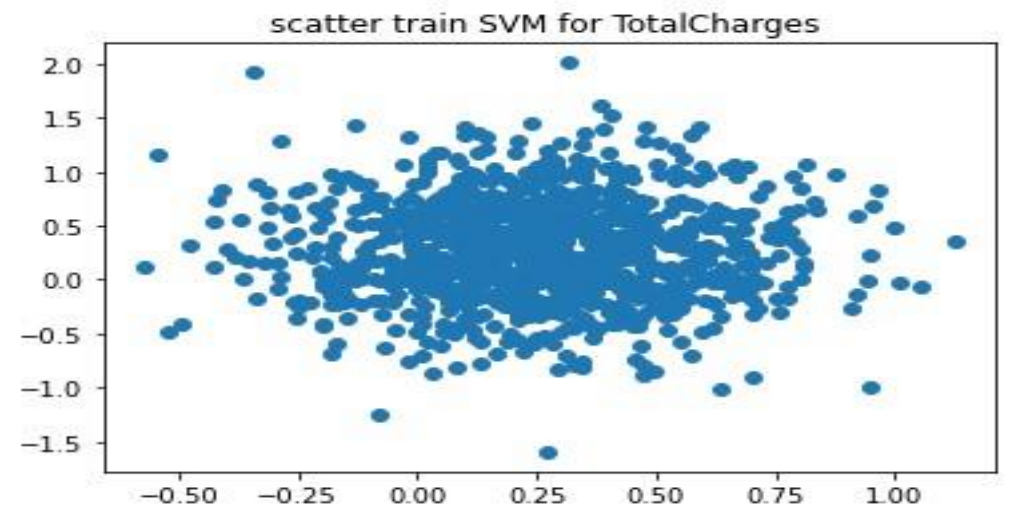
And test function takes as parameter and return it for predict function.

For scatter:

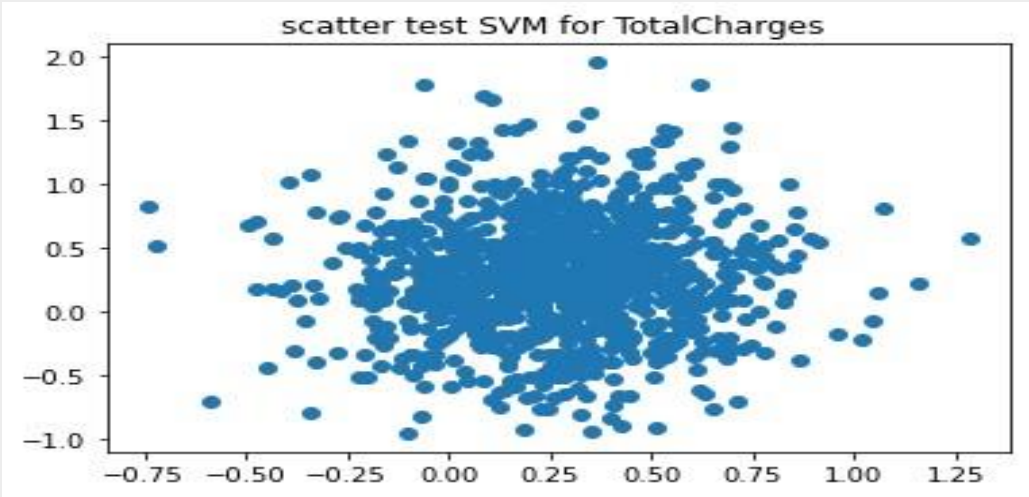
```
x = np.random.normal( 0.261309,  0.261366, 1000) #(mean,standard deviation,dots)
y = np.random.normal(0.265370, 0.441561, 1000) #(mean,standard deviation,dots)
```

For example:

Scatter train between Total Charges and churn:



Scatter test between Total Charges and churn:



For function predict:

```
def predictSvm( SV , data):
    #Predict of churn value
    
    xtest1=data
    xtest1 = xtest1.reshape(1, -1)
    ytest1=SV.predict(xtest1)
    e = "yes"
    if ytest1 == 0:
       e = "no"
    print('SVM predicted Churn is ' + str(int(ytest1[0])) + "  for  "+ e )
```

Data variable is the input from the user and reshape it then doing predict

And SV (object of SVC class) that made fit() for the data in train function and predict() for data in test function.

If predict is equal 1 then churn is YES, else the churn is NO

Decision Tree

We use: from sklearn. tree import

DecisionTreeClassifier

To make an object from DecisionTreeClassifier, so it can be used for train data.

```
model_DecTree = DecisionTreeClassifier(criterion = "gini", random_state = 10,
                                       max_depth=3, min_samples_leaf=5)
```

from sklearn. metrics import accuracy_score to show accuracy of Decision Tree.

For function Train:

Doing fitting for (x_train, y_train for Training)

```
def trainDST(x_train , y_train):

    model_DecTree.fit(x_train , y_train)
    prediction= model_DecTree.predict(x_train)
    ac_id3=accuracy_score(y_train,prediction)
    print("Decision Tree train accuracy: ",ac_id3)
```

Decision Tree Accuracy for Training: 0.7825701100461484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1995

For function Test:

Doing predict for (xtest) and finally calculate the accuracy for ytest and y predict

Taking a model_DecTree (an object of DecisionTreeClassifier) that made fit for the data in train function.

```
def testDST( model_DecTree , x_test , y_test):
    y_predict = model_DecTree.predict(x_test)
    ac=accuracy_score(y_test,y_predict)
    print('DecisionTree Accuracy : ' , ac)
    return model_DecTree
```

Decision Tree Accuracy for Testing: 0.7821149751596878

For function Predict: doing predict for (x_train for Training)

and (x_test for Testing)

```
def predictDST(model_DecTree , data):

    xtest1=data
    xtest1 = xtest1.reshape(1, -1)
    ytest1=model_DecTree.predict(xtest1)
    e = "yes"
    if ytest1 == 0:
        e = "no"
    print('Decision Tree predicted Churn is ' + str(int(ytest1[0])) + "  for  "+ e )
```

Data variable is the input from the user and reshape it then doing predict

And model_DecTree (an object of DecisionTreeClassifier) that made fit () for the data in train function and predict () for data in test function.

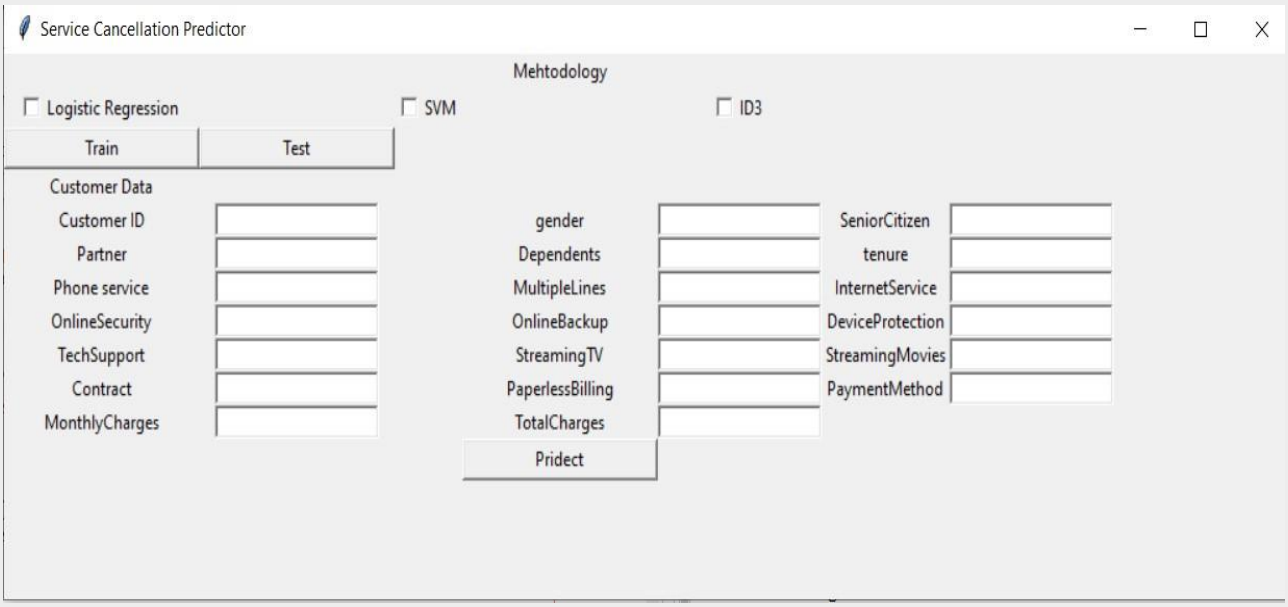
If predict is equal 1 then churn is YES, else the churn is NO

Comparing among 3 Algorithms

Algo / Accuracy	Logistic Regression	SVM	Decision Tree
train	0.8004969826056088	**0.8757543485977991**	**0.7825701100461484**
test	**0.8012775017744308**	**0.7665010645848119**	**0.7821149751596878**

GUI

GUI module:



- **We use import tkinter as tk for GUI.**
- **We use from sklearn. model_selection import train_test_split to split data.**
- **x_train, x_test, y_train, y_test =train_test_split (x, y, test_size=0.2, random_state=100)**
- **We made function to take data from Entries to make a 1D array and return it.**

```
def TakeData():
    data=np.array([senior.get() ,part.get() ,depend.get() , tenur.get() , internet.get() ,
                   onlineS.get() , onlineB.get() , device.get() , tech.get() , streamT.get()
                    , streamM.get() , contract.get() , paper.get() , payment.get() ,
                    month.get() , total.get()])
    return data
```

- we made three IntVar () variables for every check button, set it = 0 by default, as when button selected the variable = 1 other variable = 0.

```
check_value1 = tk.IntVar()
check_value2 = tk.IntVar()
check_value3 = tk.IntVar()
check_value1.set(0)
check_value2.set(0)
check_value3.set(0)
```

- we made three functions for (train data, test data, predict state) for buttons (train, test, predict) in command attribute.

```
def TrainData():
    if check_value1.get() == 1 :
          global LR
          LR = trainRegression(x_train, y_train)
    if check_value2.get() == 1 :
          global SV
          SV = trainSvm(x_train, y_train)
    if check_value3.get() == 1 :
          global DST
          DST = trainDST(x_train, y_train)


def TestData():
    if check_value1.get() == 1 :
          global LR1
          LR1 = testRegression( LR , x_test, y_test)
    if check_value2.get() == 1 :
          global SV1
          SV1 = testSvm(SV , x_test, y_test)
    if check_value3.get() == 1 :
          global DST1
          DST1 = testDST(DST , x_test, y_test)

def predict_states():
   print("Predict Algorithms:")
   d=TakeData()
   if check_value1.get()==1:
       predictRegression(LR1 , d)
   if check_value2.get()==1:
       predictSvm(SV1 , d)
   if check_value3.get()==1:
       predictDST(DST1 ,d)
```

Thanks For Your Time