SAKET MANOLKAR
UCID - sm445

SOURCE CODE

```
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.model_selection import KFold,
cross_validate, cross_val_predict
from sklearn.metrics import confusion_matrix,make_scorer
data=pd.read_csv('/Users/saketmanolkar/Downloads/
Dataset1.csv')
data

#This pice of code encodes all the string into binary
#Conversion of string to binary allows us to process data
effectively
for col in data.dtypes[data.dtypes=="object"].index:
    for_dummy= data.pop(col)

data=pd.concat([data,pd.get_dummies(for_dummy,prefix=
col)],axis=1)
    print(data)

#We define the coloumn "Change_Plan_No" in our dataset
as the label for the model
labels=data.pop("Change_Plan_No")
```

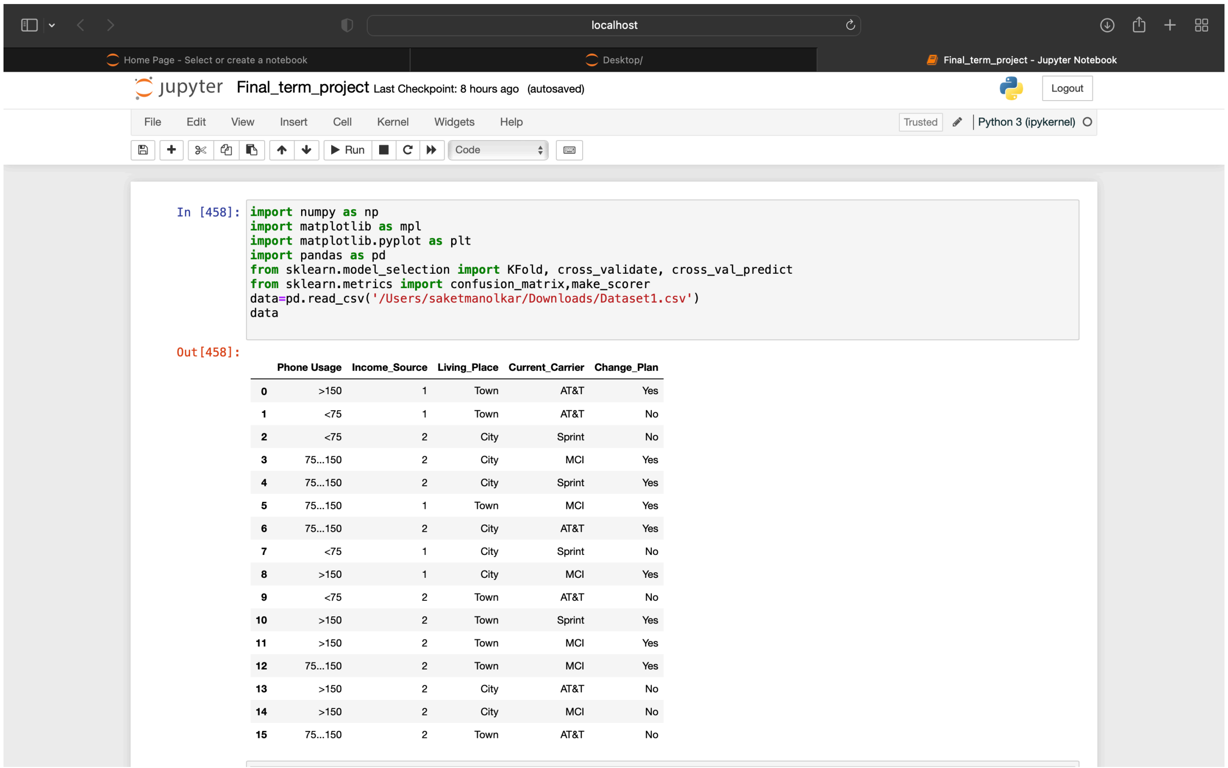
```
#This particular library allows us to split training dataset from the test dataset

from sklearn.model_selection import train_test_split
from sklearn.model_selection import cross_val_score
x_train,x_test,y_train,y_test=train_test_split(data,labels,test_size = 0.20)

def calculation():

    cnf_matrix=confusion_matrix(y_test, y_pred)
    print("Confusion matrix is:")
    print(cnf_matrix)

    FP = cnf_matrix.sum(axis=0) - np.diag(cnf_matrix)
    FN = cnf_matrix.sum(axis=1) - np.diag(cnf_matrix)
    TP = np.diag(cnf_matrix)
    TN = cnf_matrix.sum() - (FP + FN + TP)

    FP = FP.astype(float)
    print('FP: '+str(FP))
    FN = FN.astype(float)
    print('FN: '+str(FN))
    TP = TP.astype(float)
    print('TP: '+str(TP))
    TN = TN.astype(float)
    print('TN: '+str(TN))
    #True Positive rate
    TPR = TP/(TP + FN)
```

```
print('TPR: '+str(TPR))
#false positive rate
FPR = FP/(FP+TN)
print('FPR: '+str(FPR))
#False negative rate
FNR = FN/(TP+FN)
print('FNR: '+str(FNR))
#True Negative Rate
TNR = TN/(TN + FP)
print('TNR: '+str(TNR))
#Recall (r) or sensitivity
r = TP/(TP + FN)
print('r or sesitivity: '+str(r))
#F1 measure (F1)
F1 = (2 *TP)/(2 *TP + FP + FN)
print('F1: '+str(F1))
#Accuracy (Acc)
Acc = (TP + TN)/(TP + FP + FN + TN)
print('Acc: '+str(Acc))
#Error rate (Err)
Err = (FP + FN)/(TP + FP + FN + TN)
print('Err: '+str(Err))

#ROC Curve
plt.plot(FPR, TPR,'o')
plt.plot(FPR, TPR,'b')
plt.suptitle('ROC curve')
plt.xlabel('FPR')
plt.ylabel('TPR')
```

```
#rf is defined as the funciontion RandomForestClassifier()
from sklearn.ensemble import RandomForestClassifier
rf = RandomForestClassifier()
rf.fit(x_train,y_train)
y_pred=rf.predict(x_test)
print(rf.score(x_test,y_test))
print("y_pred :",y_pred)
print(calculation())

cv = KFold(n_splits=10,random_state=1,shuffle=True)
scores = cross_validate(rf,x_train,y_train,scoring =
"accuracy",cv=cv)
scores


#Classifier is defined as the funciontion
KNeighborsClassifier
from sklearn.neighbors import KNeighborsClassifier
classifier = KNeighborsClassifier(n_neighbors=5)
classifier.fit(x_train, y_train)
y_pred=classifier.predict(x_test)
print(classifier.score(x_test,y_test))
print("y_pred :",y_pred)
print(calculation())

cv = KFold(n_splits=10,random_state=1,shuffle=True)
scores = cross_validate(classifier,x_train,y_train,scoring =
"accuracy",cv=cv)
scores
```

```
#lstm is defined as the funciontion MLPClassifier
from sklearn.neural_network import MLPClassifier
lstm=MLPClassifier(solver="lbfgs",alpha=1e-5,hidden_laye
r_sizes=(5,2),random_state=1)
lstm.fit(x_train,y_train)
y_pred=lstm.predict(x_test)
print(lstm.score(x_test,y_test))
print("y_pred :",y_pred)
print(calculation())

cv = KFold(n_splits=10,random_state=1,shuffle=True)
scores = cross_validate(lstm,x_train,y_train,scoring =
"accuracy",cv=cv)
scores
```

SCREEN SHOTS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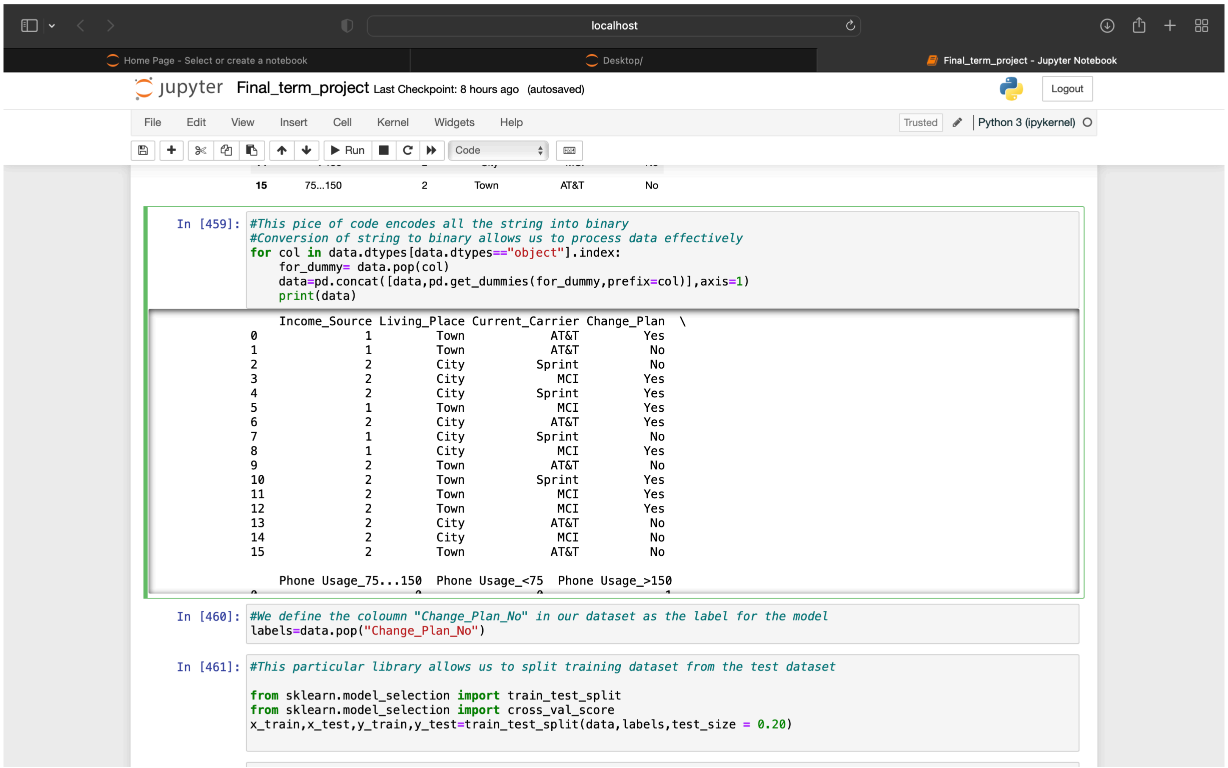
In [458]:

```
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.model_selection import KFold, cross_validate, cross_val_predict
from sklearn.metrics import confusion_matrix,make_scorer
data=pd.read_csv('/Users/saketmanolkar/Downloads/Dataset1.csv')
data
```

Out[458]:

	Phone Usage	Income_Source	Living_Place	Current_Carrier	Change_Plan
0	>150	1	Town	AT&T	Yes
1	<75	1	Town	AT&T	No
2	<75	2	City	Sprint	No
3	75...150	2	City	MCI	Yes
4	75...150	2	City	Sprint	Yes
5	75...150	1	Town	MCI	Yes
6	75...150	2	City	AT&T	Yes
7	<75	1	City	Sprint	No
8	>150	1	City	MCI	Yes
9	<75	2	Town	AT&T	No
10	>150	2	Town	Sprint	Yes
11	>150	2	Town	MCI	Yes
12	75...150	2	Town	MCI	Yes
13	>150	2	City	AT&T	No
14	>150	2	City	MCI	No
15	75...150	2	Town	AT&T	No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Python 3 (ipykernel)
Run
Code

15	75...150	2	Town	AT&T	No

In [459]:

```
#This pice of code encodes all the string into binary
#Conversion of string to binary allows us to process data effectively
for col in data.dtypes[data.dtypes=="object"].index:
    for_dummy= data.pop(col)
    data=pd.concat([data,pd.get_dummies(for_dummy,prefix=col)],axis=1)
    print(data)
```

```
    Income_Source Living_Place Current_Carrier Change_Plan  \
0               1         Town            AT&T         Yes
1               1         Town            AT&T          No
2               2         City          Sprint          No
3               2         City             MCI         Yes
4               2         City          Sprint         Yes
5               1         Town             MCI         Yes
6               2         City            AT&T         Yes
7               1         City          Sprint          No
8               1         City             MCI         Yes
9               2         Town            AT&T          No
10              2         Town          Sprint         Yes
11              2         Town             MCI         Yes
12              2         Town             MCI         Yes
13              2         City            AT&T          No
14              2         City             MCI          No
15              2         Town            AT&T          No

    Phone Usage_75...150  Phone Usage_<75  Phone Usage_>150
```

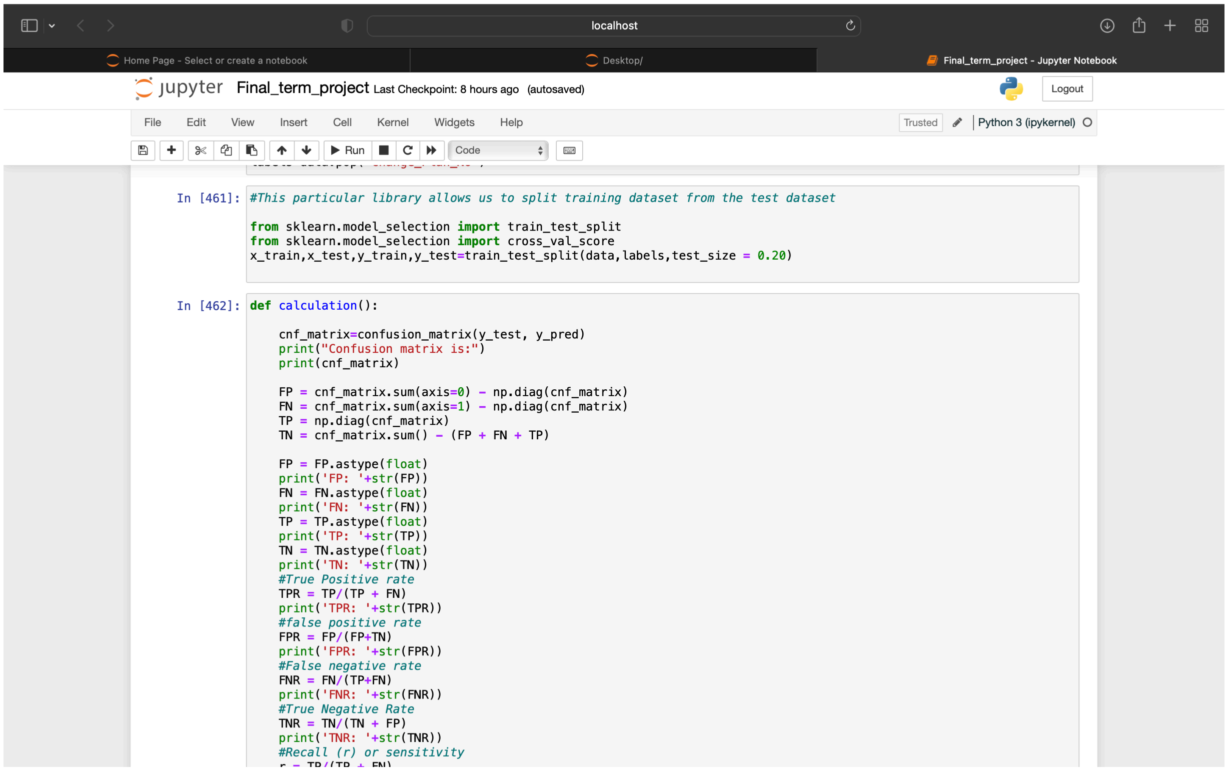
In [460]:

```
#We define the coloumn "Change_Plan_No" in our dataset as the label for the model
labels=data.pop("Change_Plan_No")
```

In [461]:

```
#This particular library allows us to split training dataset from the test dataset

from sklearn.model_selection import train_test_split
from sklearn.model_selection import cross_val_score
x_train,x_test,y_train,y_test=train_test_split(data,labels,test_size = 0.20)
```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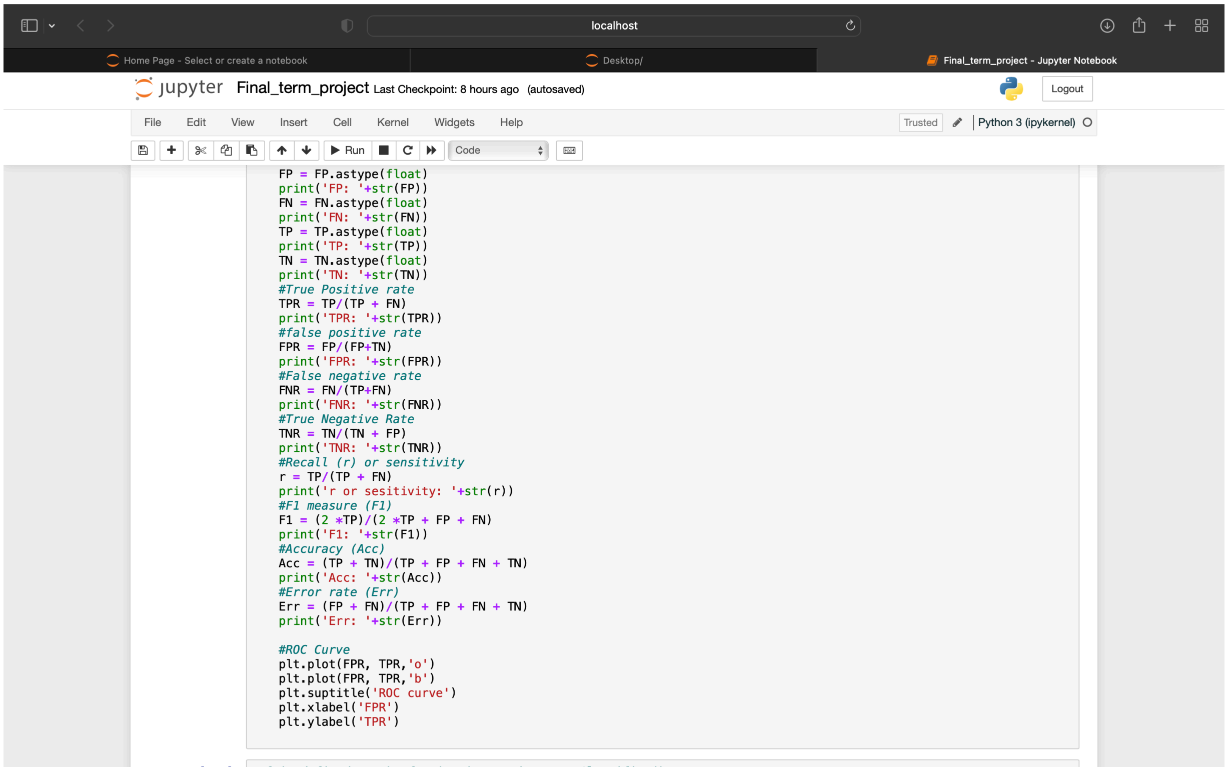
Python 3 (ipykernel)
Run
Code

```
In [461]: #This particular library allows us to split training dataset from the test dataset

          from sklearn.model_selection import train_test_split
          from sklearn.model_selection import cross_val_score
          x_train,x_test,y_train,y_test=train_test_split(data,labels,test_size = 0.20)
```

```
In [462]: def calculation():

              cnf_matrix=confusion_matrix(y_test, y_pred)
              print("Confusion matrix is:")
              print(cnf_matrix)

              FP = cnf_matrix.sum(axis=0) - np.diag(cnf_matrix)
              FN = cnf_matrix.sum(axis=1) - np.diag(cnf_matrix)
              TP = np.diag(cnf_matrix)
              TN = cnf_matrix.sum() - (FP + FN + TP)

              FP = FP.astype(float)
              print('FP: '+str(FP))
              FN = FN.astype(float)
              print('FN: '+str(FN))
              TP = TP.astype(float)
              print('TP: '+str(TP))
              TN = TN.astype(float)
              print('TN: '+str(TN))
              #True Positive rate
              TPR = TP/(TP + FN)
              print('TPR: '+str(TPR))
              #false positive rate
              FPR = FP/(FP+TN)
              print('FPR: '+str(FPR))
              #False negative rate
              FNR = FN/(TP+FN)
              print('FNR: '+str(FNR))
              #True Negative Rate
              TNR = TN/(TN + FP)
              print('TNR: '+str(TNR))
              #Recall (r) or sensitivity
              r = TP/(TP + FN)
```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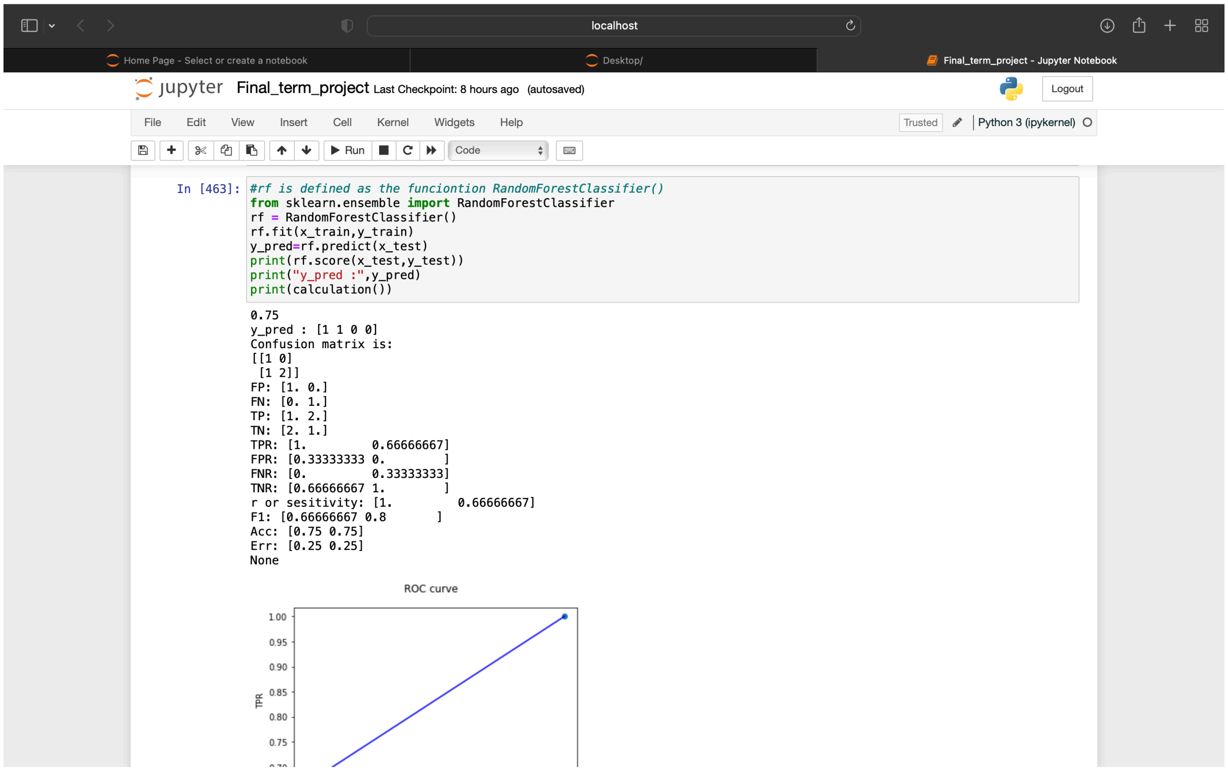
Python 3 (ipykernel)
Run
Code

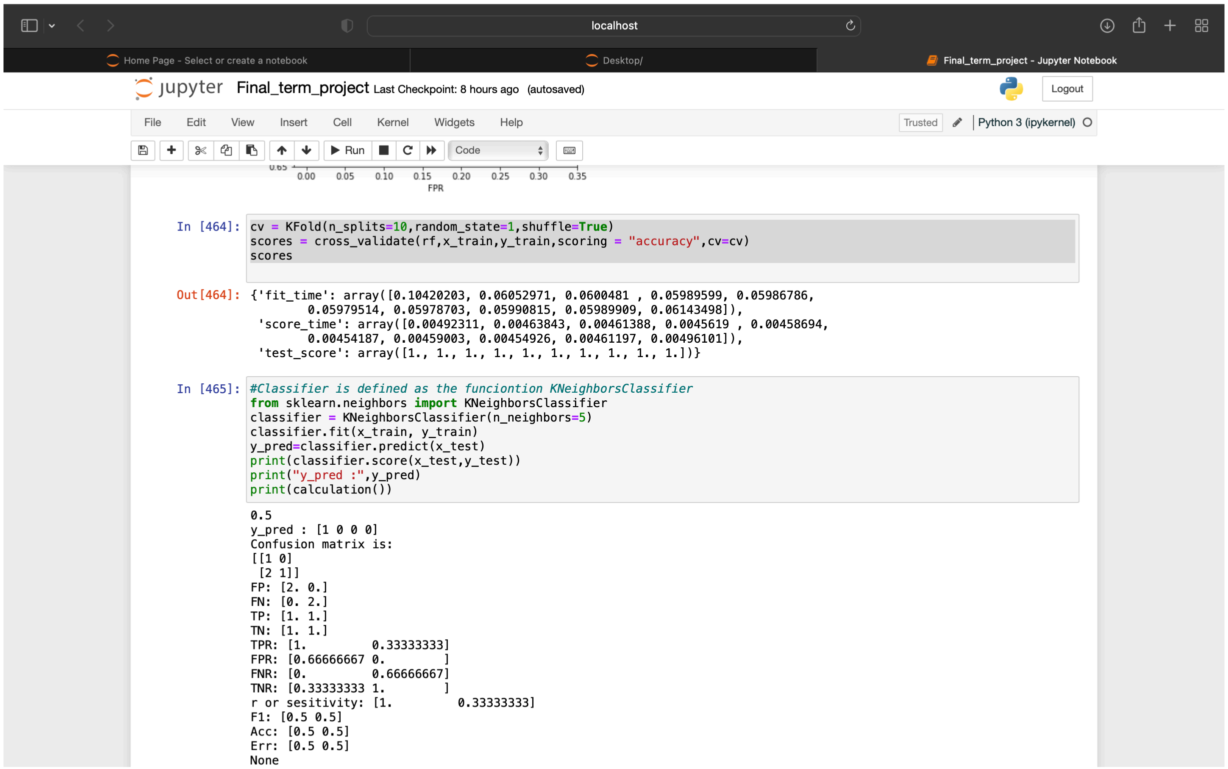
```
    FP = FP.astype(float)
    print('FP: '+str(FP))
    FN = FN.astype(float)
    print('FN: '+str(FN))
    TP = TP.astype(float)
    print('TP: '+str(TP))
    TN = TN.astype(float)
    print('TN: '+str(TN))
    #True Positive rate
    TPR = TP/(TP + FN)
    print('TPR: '+str(TPR))
    #false positive rate
    FPR = FP/(FP+TN)
    print('FPR: '+str(FPR))
    #False negative rate
    FNR = FN/(TP+FN)
    print('FNR: '+str(FNR))
    #True Negative Rate
    TNR = TN/(TN + FP)
    print('TNR: '+str(TNR))
    #Recall (r) or sensitivity
    r = TP/(TP + FN)
    print('r or sesitivity: '+str(r))
    #F1 measure (F1)
    F1 = (2 *TP)/(2 *TP + FP + FN)
    print('F1: '+str(F1))
    #Accuracy (Acc)
    Acc = (TP + TN)/(TP + FP + FN + TN)
    print('Acc: '+str(Acc))
    #Error rate (Err)
    Err = (FP + FN)/(TP + FP + FN + TN)
    print('Err: '+str(Err))

    #ROC Curve
    plt.plot(FPR, TPR,'o')
    plt.plot(FPR, TPR,'b')
    plt.suptitle('ROC curve')
    plt.xlabel('FPR')
    plt.ylabel('TPR')
```



```
In [463]: #rf is defined as the funciontion RandomForestClassifier()
          from sklearn.ensemble import RandomForestClassifier
          rf = RandomForestClassifier()
          rf.fit(x_train,y_train)
          y_pred=rf.predict(x_test)
          print(rf.score(x_test,y_test))
          print("y_pred :",y_pred)
          print(calculation())
```

```
0.75
y_pred : [1 1 0 0]
Confusion matrix is:
[[1 0]
 [1 2]]
FP: [1. 0.]
FN: [0. 1.]
TP: [1. 2.]
TN: [2. 1.]
TPR: [1.         0.66666667]
FPR: [0.33333333 0.        ]
FNR: [0.         0.33333333]
TNR: [0.66666667 1.        ]
r or sesitivity: [1.         0.66666667]
F1: [0.66666667 0.8       ]
Acc: [0.75 0.75]
Err: [0.25 0.25]
None
```

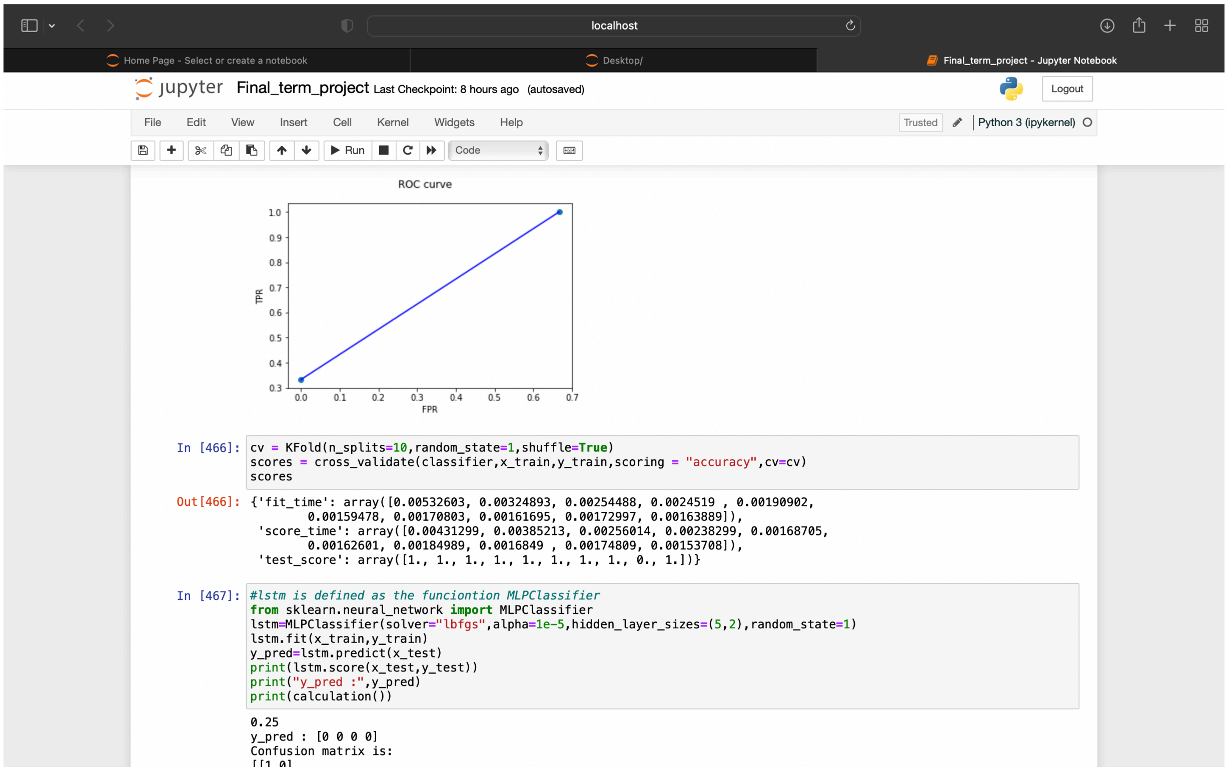


```
In [464]: cv = KFold(n_splits=10,random_state=1,shuffle=True)
          scores = cross_validate(rf,x_train,y_train,scoring = "accuracy",cv=cv)
          scores
```

```
Out[464]: {'fit_time': array([0.10420203, 0.06052971, 0.0600481 , 0.05989599, 0.05986786,
                 0.05979514, 0.05978703, 0.05990815, 0.05989909, 0.06143498]),
           'score_time': array([0.00492311, 0.00463843, 0.00461388, 0.0045619 , 0.00458694,
                 0.00454187, 0.00459003, 0.00454926, 0.00461197, 0.00496101]),
           'test_score': array([1., 1., 1., 1., 1., 1., 1., 1., 1., 1.])}
```

```
In [465]: #Classifier is defined as the funciontion KNeighborsClassifier
          from sklearn.neighbors import KNeighborsClassifier
          classifier = KNeighborsClassifier(n_neighbors=5)
          classifier.fit(x_train, y_train)
          y_pred=classifier.predict(x_test)
          print(classifier.score(x_test,y_test))
          print("y_pred :",y_pred)
          print(calculation())
```

```
0.5
y_pred : [1 0 0 0]
Confusion matrix is:
[[1 0]
 [2 1]]
FP: [2. 0.]
FN: [0. 2.]
TP: [1. 1.]
TN: [1. 1.]
TPR: [1.         0.33333333]
FPR: [0.66666667 0.        ]
FNR: [0.         0.66666667]
TNR: [0.33333333 1.        ]
r or sesitivity: [1.         0.33333333]
F1: [0.5 0.5]
Acc: [0.5 0.5]
Err: [0.5 0.5]
None
```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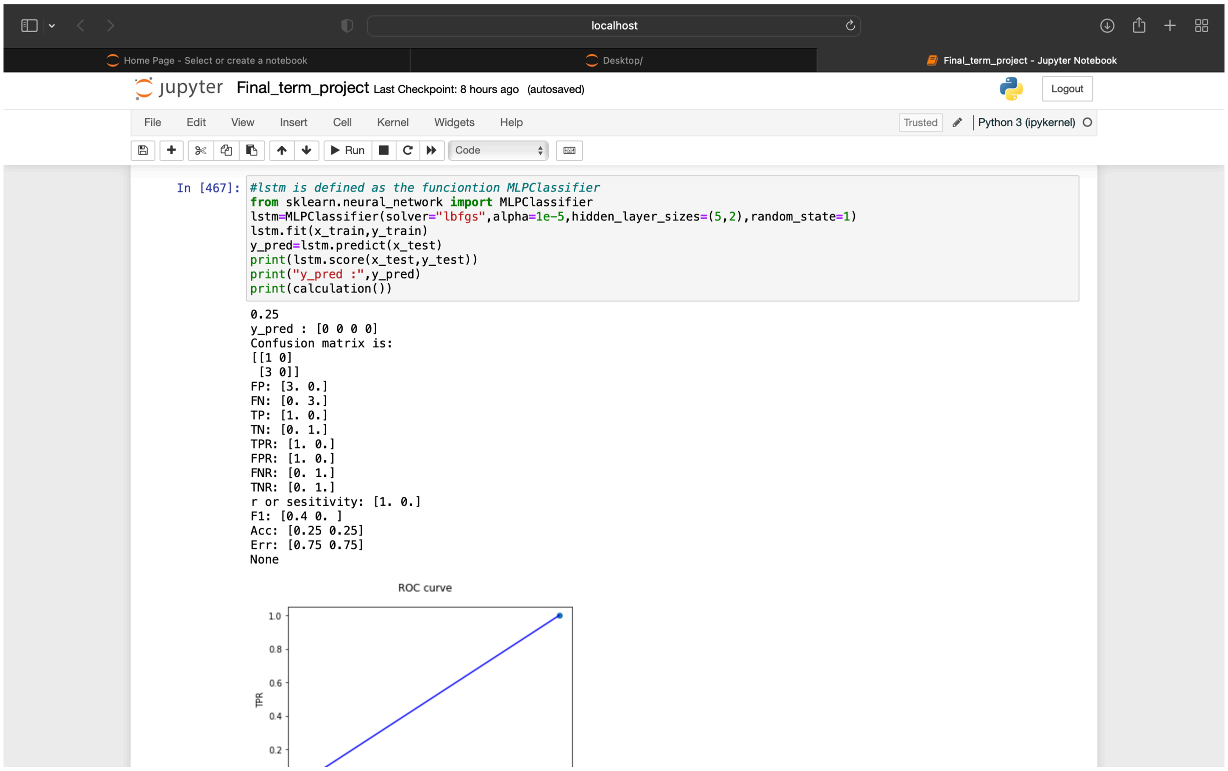
Python 3 (ipykernel)
Run
Code
ROC curve
TPR
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
FPR

In [466]:
```
cv = KFold(n_splits=10,random_state=1,shuffle=True)
scores = cross_validate(classifier,x_train,y_train,scoring = "accuracy",cv=cv)
scores
```

Out[466]:
```
{'fit_time': array([0.00532603, 0.00324893, 0.00254488, 0.0024519 , 0.00190902,
        0.00159478, 0.00170803, 0.00161695, 0.00172997, 0.00163889]),
 'score_time': array([0.00431299, 0.00385213, 0.00256014, 0.00238299, 0.00168705,
        0.00162601, 0.00184989, 0.0016849 , 0.00174809, 0.00153708]),
 'test_score': array([1., 1., 1., 1., 1., 1., 1., 1., 0., 1.])}
```

In [467]:
```
#lstm is defined as the funciontion MLPClassifier
from sklearn.neural_network import MLPClassifier
lstm=MLPClassifier(solver="lbfgs",alpha=1e-5,hidden_layer_sizes=(5,2),random_state=1)
lstm.fit(x_train,y_train)
y_pred=lstm.predict(x_test)
print(lstm.score(x_test,y_test))
print("y_pred :",y_pred)
print(calculation())
```

```
0.25
y_pred : [0 0 0 0]
Confusion matrix is:
[[1 0]
```


localhost
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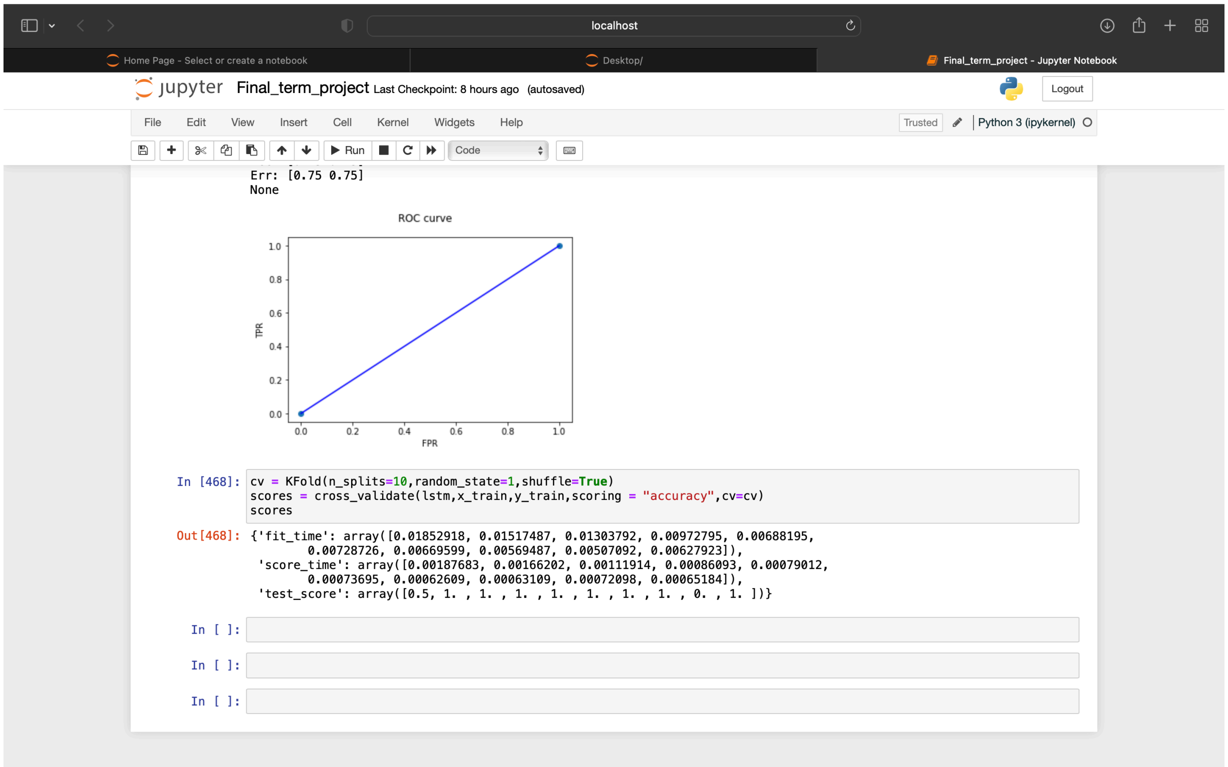
Trusted
Python 3 (ipykernel)
Run
Code
ROC curve
TPR
1.0
0.8
0.6
0.4
0.2

In [467]:
```
#lstm is defined as the funciontion MLPClassifier
from sklearn.neural_network import MLPClassifier
lstm=MLPClassifier(solver="lbfgs",alpha=1e-5,hidden_layer_sizes=(5,2),random_state=1)
lstm.fit(x_train,y_train)
y_pred=lstm.predict(x_test)
print(lstm.score(x_test,y_test))
print("y_pred :",y_pred)
print(calculation())
```

```
0.25
y_pred : [0 0 0 0]
Confusion matrix is:
[[1 0]
 [3 0]]
FP: [3. 0.]
FN: [0. 3.]
TP: [1. 0.]
TN: [0. 1.]
TPR: [1. 0.]
FPR: [1. 0.]
FNR: [0. 1.]
TNR: [0. 1.]
r or sesitivity: [1. 0.]
F1: [0.4 0. ]
Acc: [0.25 0.25]
Err: [0.75 0.75]
None
```



```
Err: [0.75 0.75]
None
```

```
In [468]: cv = KFold(n_splits=10,random_state=1,shuffle=True)
          scores = cross_validate(lstm,x_train,y_train,scoring = "accuracy",cv=cv)
          scores
```

```
Out[468]: {'fit_time': array([0.01852918, 0.01517487, 0.01303792, 0.00972795, 0.00688195,
                  0.00728726, 0.00669599, 0.00569487, 0.00507092, 0.00627923]),
           'score_time': array([0.00187683, 0.00166202, 0.00111914, 0.00086093, 0.00079012,
                  0.00073695, 0.00062609, 0.00063109, 0.00072098, 0.00065184]),
           'test_score': array([0.5, 1. , 1. , 1. , 1. , 1. , 1. , 1. , 0. , 1. ])}
```

```
In [ ]:

In [ ]:

In [ ]:
```