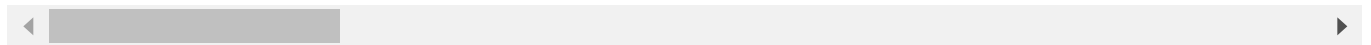```
import numpy as np
import pandas as pd
df = pd.read_csv(r"data01.csv")
df.head()
```

| | gender | PPE | DFA | RPDE | numPulses | numPeriodsPulses | meanPeriodPulses | stdI |
|---|---|---|---|---|---|---|---|---|
| **0** | 1 | 0.85247 | 0.71826 | 0.57227 | 240 | 239 | 0.008064 | |
| **1** | 1 | 0.76686 | 0.69481 | 0.53966 | 234 | 233 | 0.008258 | |
| **2** | 1 | 0.85083 | 0.67604 | 0.58982 | 232 | 231 | 0.008340 | |
| **3** | 0 | 0.41121 | 0.79672 | 0.59257 | 178 | 177 | 0.010858 | |
| **4** | 0 | 0.32790 | 0.79782 | 0.53028 | 236 | 235 | 0.008162 | |

5 rows × 754 columns

## ▾ DATA CLEANING

df

| | gender | PPE | DFA | RPDE | numPulses | numPeriodsPulses | meanPeriodPulses | st |
|---|---|---|---|---|---|---|---|---|
| **0** | 1 | 0.85247 | 0.71826 | 0.57227 | 240 | 239 | 0.008064 | |
| **1** | 1 | 0.76686 | 0.69481 | 0.53966 | 234 | 233 | 0.008258 | |
| **2** | 1 | 0.85083 | 0.67604 | 0.58982 | 232 | 231 | 0.008340 | |
| **3** | 0 | 0.41121 | 0.79672 | 0.59257 | 178 | 177 | 0.010858 | |
| **4** | 0 | 0.32790 | 0.79782 | 0.53028 | 236 | 235 | 0.008162 | |
| **...** | ... | ... | ... | ... | ... | ... | ... | |
| **751** | 0 | 0.80903 | 0.56355 | 0.28385 | 417 | 416 | 0.004627 | |
| **752** | 0 | 0.16084 | 0.56499 | 0.59194 | 415 | 413 | 0.004550 | |
| **753** | 0 | 0.88389 | 0.72335 | 0.46815 | 381 | 380 | 0.005069 | |
| **754** | 0 | 0.83782 | 0.74890 | 0.49823 | 340 | 339 | 0.005679 | |
| **755** | 0 | 0.81304 | 0.76471 | 0.46374 | 340 | 339 | 0.005676 | |

756 rows × 754 columns
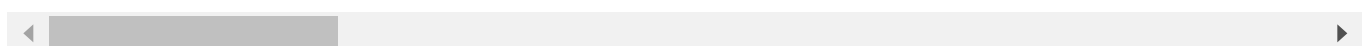
```
len(df.status.unique())
```

```
2
```

```
df.columns
```

```
Index(['gender', 'PPE', 'DFA', 'RPDE', 'numPulses', 'numPeriodsPulses',
       'meanPeriodPulses', 'stdDevPeriodPulses', 'locPctJitter',
       'locAbsJitter',
       ...
       'tqwt_kurtosisValue_dec_28', 'tqwt_kurtosisValue_dec_29',
       'tqwt_kurtosisValue_dec_30', 'tqwt_kurtosisValue_dec_31',
       'tqwt_kurtosisValue_dec_32', 'tqwt_kurtosisValue_dec_33',
       'tqwt_kurtosisValue_dec_34', 'tqwt_kurtosisValue_dec_35',
       'tqwt_kurtosisValue_dec_36', 'status'],
      dtype='object', length=754)
```

```
df.shape
```

```
(756, 754)
```

```
df[df['status']==1].shape
```

```
(564, 754)
```

```
df[df['status']==0].shape
```

```
(192, 754)
```

```
df.isna().sum()
```

```
gender                        0
PPE                           0
DFA                           0
RPDE                          0
numPulses                     0
                             ..
tqwt_kurtosisValue_dec_33     0
tqwt_kurtosisValue_dec_34     0
tqwt_kurtosisValue_dec_35     0
tqwt_kurtosisValue_dec_36     0
status                        0
Length: 754, dtype: int64
```

```
df.isnull().sum()
```

```
gender                        0
PPE                           0
DFA                           0
RPDE                          0
numPulses                     0
```

```
                                          ..
            tqwt_kurtosisValue_dec_33      0
            tqwt_kurtosisValue_dec_34      0
            tqwt_kurtosisValue_dec_35      0
            tqwt_kurtosisValue_dec_36      0
            status                         0
            Length: 754, dtype: int64
```

```python
#scaling the inputs
from sklearn.preprocessing import StandardScaler
```

```python
x = df.drop(['status'], axis = 1)
y = df['status']
```

```python
std = StandardScaler()
X = np.array(std.fit_transform(x))
```

```python
X
```

```
        array([[ 0.96874225,  0.62764391,  0.2561442 , ..., -0.775137  ,
                 -0.81472704, -0.36659507],
               [ 0.96874225,  0.12161952, -0.08043329, ..., -0.52664699,
                 -0.58297219,  0.40039616],
               [ 0.96874225,  0.61795018, -0.34983882, ..., -0.75606253,
                 -0.8043897 , -0.7809355 ],
               ...,
               [-1.03226633,  0.81336154,  0.3292009 , ..., -0.71674252,
                 -0.79017671, -0.77287314],
               [-1.03226633,  0.54105055,  0.69591966, ..., -0.77132466,
                 -0.82631929, -0.81173208],
               [-1.03226633,  0.3945807 ,  0.92284035, ..., -0.68658105,
                 -0.84098293, -0.82811405]])
```

▾ TRAIN TEST SPLIT

```python
from sklearn.model_selection import train_test_split
```

```python
X_train, X_test, Y_train, Y_test = train_test_split(x,y,test_size=0.2,random_state=10)
```

```python
print(X_train.shape)
print(X_test.shape)
print(Y_train.shape)
print(Y_test.shape)
```

```
        (604, 753)
```

```
(152, 753)
(604,)
(152,)
```

```python
X_train = np.array(X_train)
```

```python
Y_train = np.array(Y_train)
```

```python
X_test = np.array(X_test)
```

```python
Y_test = np.array(Y_test)
```

```python
len(Y_test)
```

```
152
```

▾ MODEL 1 - LINEAR REGRESSION

```python
from sklearn.linear_model import LinearRegression
lr = LinearRegression()
```

```python
lr.fit(X_train, Y_train)
```

```
LinearRegression()
```

```python
predictions_model1 = lr.predict(X_test)
predictions_model1
```

```
array([ 6.66060788e-01,  1.15916820e+00, -4.04843286e-01,  8.93080459e+00,
        9.98247565e-01,  1.84172348e+00, -2.58767119e-01, -2.82034260e-01,
       -2.01480637e-01,  1.98183256e-01,  1.77016821e+00, -2.94276825e+00,
        1.31421301e+00,  2.67206451e+00,  7.22152205e-01,  1.20300326e+00,
        3.68625584e-01, -1.09906470e+00,  2.19154667e+00,  6.95811017e+00,
        5.70049003e+00,  1.95622110e+00, -1.74091991e+00, -1.68429614e+01,
        9.16911454e-01, -7.24949536e-01,  9.33688303e-01, -3.58429037e+00,
       -2.27335430e+00,  1.08453565e+00,  3.09726255e+00,  1.40287870e-01,
        4.51931232e-01, -4.79786259e+01, -8.63525979e+01, -6.33459714e-01,
        7.05167147e+00,  2.53934504e+00,  7.49577665e-01, -6.18804000e-01,
        6.07269374e+00,  1.85091064e+00,  1.43108548e+00, -1.63255941e-01,
        8.71336042e-01,  4.29558767e-01, -1.08104433e+00,  7.77375063e-01,
        2.10638192e+00, -7.53710112e-02, -1.29070585e+00, -4.70638143e-01,
        2.08491621e+00,  1.13277424e+00,  3.26046288e+00,  4.29292562e+01,
        3.79203938e-01,  1.16034315e+00,  1.79117254e+00,  3.20362177e-02,
        1.99366880e+00, -1.47589491e+00, -5.02662369e+00,  1.51071901e+00,
       -9.37053305e-02,  2.26743962e+00, -2.62436884e-01,  1.02714612e+00,
```

```
          3.93142025e+00,  1.99886140e+00, -1.50864857e-01,  4.36964424e+00,
          1.04336304e+00,  1.80328443e+00,  1.75519874e+00, -5.62266178e-01,
         -8.84228584e-01,  2.31812009e-01, -2.00665323e+00,  1.99917090e+00,
         -3.40002920e+00, -7.51143859e+00,  2.10164727e+00, -7.72614558e-01,
         -2.37477320e+00,  8.06913284e-01,  1.50721815e+00,  1.63716556e+00,
         -4.79517150e-02, -1.32381991e+00,  1.73026242e+00, -2.42591361e-01,
         -1.40464471e-01,  2.30280840e+00, -2.91280146e-01, -2.25488342e+01,
         -1.83235958e+00,  6.16270460e-01, -1.17039028e+00,  7.70621863e+00,
          1.17172922e+00,  1.00687089e+00,  1.68355999e-01,  7.12647256e-02,
          1.65662527e+00,  7.51974549e+00,  1.17359738e+00,  2.43188884e+00,
          1.99770158e+00,  2.61819820e+00,  2.50752821e+00,  8.90734433e-01,
          8.22941920e-01, -2.30186582e+01,  8.97789821e-01,  1.94555335e+00,
          8.84733061e-01,  2.87980183e+00,  4.42872749e+02,  1.67744333e+00,
          6.68864801e-01,  7.48194502e-01,  1.19139279e+00,  1.22092711e+00,
         -2.10733989e+00,  5.31911251e-01,  7.12443940e+00, -4.70671054e+00,
          1.55088295e+00, -2.44137707e-01,  1.15008553e+00,  2.64941462e+00,
          3.16364721e-01,  4.27002552e+00,  1.23541279e+00,  3.79850290e-01,
          1.32041778e+00, -4.48064827e+00, -5.49636850e-01,  1.18265344e-01,
         -3.33101311e+00,  2.84040478e+00,  4.15075183e-01,  3.11227090e+00,
          2.55873771e+00, -5.91915984e-01,  9.42960777e-01,  4.12773728e+00,
          2.53399838e+00, -9.52335849e+00,  1.63786066e+00,  4.32572237e+02])
```

```
for i,j in enumerate(predictions_model1):
    if(j<0.5):
        predictions_model1[i]=0
    else:
        predictions_model1[i]=1
print(predictions_model1)
predictions_model1.shape
```

```
    [1. 1. 0. 1. 1. 1. 0. 0. 0. 0. 1. 0. 1. 1. 1. 1. 0. 0. 1. 1. 1. 1. 0. 0.
     1. 0. 1. 0. 0. 1. 1. 0. 0. 0. 0. 0. 1. 1. 1. 0. 1. 1. 1. 0. 1. 0. 0. 1.
     1. 0. 0. 0. 1. 1. 1. 1. 0. 1. 1. 0. 1. 0. 0. 1. 0. 1. 0. 1. 1. 1. 0. 1.
     1. 1. 1. 0. 0. 0. 0. 1. 0. 0. 1. 0. 0. 1. 1. 1. 0. 0. 1. 0. 0. 1. 0. 0.
     0. 1. 0. 1. 1. 1. 0. 0. 1. 1. 1. 1. 1. 1. 1. 1. 0. 1. 1. 1. 1. 1. 1.
     1. 1. 1. 1. 0. 1. 1. 0. 1. 0. 1. 1. 0. 1. 1. 0. 1. 0. 0. 0. 0. 1. 0. 1.
     1. 0. 1. 1. 1. 0. 1. 1.]
    (152,)
```

```
Y_test = np.array(Y_test)
```

```
print(Y_test)
Y_test.shape
```

```
    [1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1
     1 0 1 1 1 1 1 0 1 0 1 1 1 0 0 0 1 1 1 1 1 0 0 1 0 1 1 1 0 1 1 1 0 1 1 1
     1 1 1 1 1 1 0 0 0 1 1 1 0 1 1 0 0 1 1 1 1 1 0 0 0 1 1 1 1 1 1 1 1
     0 1 0 1 1 1 1 0 0 1 0 0 1 0 1 1 1 1 0 1 1 1 1 0 1 1 1 0 1 1 1 1 1 1 1 1 1
     1 0 1 1]
    (152,)
```

```
print("X_test_array      Y_test")
for i,j in zip(predictions_model1, Y_test):
    print(i, "              ", j)
```

```
    X_test_array        Y_test
    1.0                  1
    1.0                  1
    0.0                  1
    1.0                  1
    1.0                  1
    1.0                  1
    0.0                  1
    0.0                  1
    0.0                  1
    0.0                  1
    1.0                  1
    0.0                  1
    1.0                  1
    1.0                  1
    1.0                  0
    1.0                  1
    0.0                  1
    0.0                  1
    1.0                  0
    1.0                  1
    1.0                  1
    1.0                  1
    0.0                  1
    0.0                  1
    1.0                  1
    0.0                  1
    1.0                  1
    0.0                  1
    0.0                  1
    1.0                  1
    1.0                  1
    0.0                  1
    0.0                  1
    0.0                  1
    0.0                  0
    0.0                  1
    1.0                  1
    1.0                  1
    1.0                  0
    0.0                  1
    1.0                  1
    1.0                  1
    1.0                  1
    0.0                  1
    1.0                  0
    0.0                  1
    0.0                  0
    1.0                  1
    1.0                  1
    0.0                  1
    0.0                  0
```

```
        0.0                    0
        1.0                    0
        1.0                    1
        1.0                    1
        1.0                    1
        0.0                    1
```

```
print("Linear Regression Accuracy :\n")
lr.score(X_test, Y_test)
```

        Linear Regression Accuracy :

        -15012.89551445458

```
Y_pred= lr.predict(X_test)
```

```
import matplotlib.pyplot as plt
plt.plot(X_test, Y_pred, color='blue')
```

```
[<matplotlib.lines.Line2D at 0x7f4b207f72d0>,
 <matplotlib.lines.Line2D at 0x7f4b207f7a90>,
 <matplotlib.lines.Line2D at 0x7f4b207f7fd0>,
 <matplotlib.lines.Line2D at 0x7f4b207f7c10>,
 <matplotlib.lines.Line2D at 0x7f4b207f7b10>,
 <matplotlib.lines.Line2D at 0x7f4b207f7dd0>,
 <matplotlib.lines.Line2D at 0x7f4b2077b8d0>,
 <matplotlib.lines.Line2D at 0x7f4b24879390>,
 <matplotlib.lines.Line2D at 0x7f4b249296d0>,
 <matplotlib.lines.Line2D at 0x7f4b207f7890>,
 <matplotlib.lines.Line2D at 0x7f4b207a52d0>,
 <matplotlib.lines.Line2D at 0x7f4b24926610>,
 <matplotlib.lines.Line2D at 0x7f4b248c1a90>,
 <matplotlib.lines.Line2D at 0x7f4b2487f7d0>,
 <matplotlib.lines.Line2D at 0x7f4b2487fc90>,
 <matplotlib.lines.Line2D at 0x7f4b207dfd90>,
 <matplotlib.lines.Line2D at 0x7f4b20798b90>,
 <matplotlib.lines.Line2D at 0x7f4b207c76d0>,
 <matplotlib.lines.Line2D at 0x7f4b207d0190>,
 <matplotlib.lines.Line2D at 0x7f4b20715290>,
 <matplotlib.lines.Line2D at 0x7f4b20715c10>,
 <matplotlib.lines.Line2D at 0x7f4b20715550>,
 <matplotlib.lines.Line2D at 0x7f4b20715590>,
 <matplotlib.lines.Line2D at 0x7f4b20715310>,
 <matplotlib.lines.Line2D at 0x7f4b207150d0>,
 <matplotlib.lines.Line2D at 0x7f4b20715690>,
 <matplotlib.lines.Line2D at 0x7f4b20715c90>,
 <matplotlib.lines.Line2D at 0x7f4b24933c90>,
 <matplotlib.lines.Line2D at 0x7f4b2317dc90>,
 <matplotlib.lines.Line2D at 0x7f4b21fe51d0>,
 <matplotlib.lines.Line2D at 0x7f4b21fe5ed0>,
 <matplotlib.lines.Line2D at 0x7f4b8f936290>,
 <matplotlib.lines.Line2D at 0x7f4b24a2f290>,
 <matplotlib.lines.Line2D at 0x7f4b2492c110>,
 <matplotlib.lines.Line2D at 0x7f4b207218d0>,
 <matplotlib.lines.Line2D at 0x7f4b20721850>,
 <matplotlib.lines.Line2D at 0x7f4b20721fd0>,
 <matplotlib.lines.Line2D at 0x7f4b20721290>,
 <matplotlib.lines.Line2D at 0x7f4b20721250>,
 <matplotlib.lines.Line2D at 0x7f4b20721d50>,
 <matplotlib.lines.Line2D at 0x7f4b20721a10>,
 <matplotlib.lines.Line2D at 0x7f4b24889490>,
 <matplotlib.lines.Line2D at 0x7f4b24889650>,
 <matplotlib.lines.Line2D at 0x7f4b24889090>,
 <matplotlib.lines.Line2D at 0x7f4b21eb7190>,
 <matplotlib.lines.Line2D at 0x7f4b21eb7350>,
 <matplotlib.lines.Line2D at 0x7f4b21eb7510>,
 <matplotlib.lines.Line2D at 0x7f4b21eb76d0>,
 <matplotlib.lines.Line2D at 0x7f4b21eb7890>,
 <matplotlib.lines.Line2D at 0x7f4b21eb7a50>,
 <matplotlib.lines.Line2D at 0x7f4b21eb7c10>,
 <matplotlib.lines.Line2D at 0x7f4b21eb7dd0>,
 <matplotlib.lines.Line2D at 0x7f4b21eb7f90>,
 <matplotlib.lines.Line2D at 0x7f4b21ecc190>,
 <matplotlib.lines.Line2D at 0x7f4b21ecc350>,
 <matplotlib.lines.Line2D at 0x7f4b21ecc510>,
```

```
<matplotlib.lines.Line2D at 0x7f4b21ecc6d0>,
<matplotlib.lines.Line2D at 0x7f4b21ecc890>,
<matplotlib.lines.Line2D at 0x7f4b21ecca50>,
<matplotlib.lines.Line2D at 0x7f4b21eccc10>,
<matplotlib.lines.Line2D at 0x7f4b21eccdd0>,
<matplotlib.lines.Line2D at 0x7f4b21eccf90>,
<matplotlib.lines.Line2D at 0x7f4b21ed9190>,
<matplotlib.lines.Line2D at 0x7f4b21ed9350>,
<matplotlib.lines.Line2D at 0x7f4b21ed9510>,
<matplotlib.lines.Line2D at 0x7f4b21ed96d0>,
<matplotlib.lines.Line2D at 0x7f4b21ed9890>,
<matplotlib.lines.Line2D at 0x7f4b21ed9a50>,
<matplotlib.lines.Line2D at 0x7f4b21ed9c10>,
<matplotlib.lines.Line2D at 0x7f4b21ed9dd0>,
<matplotlib.lines.Line2D at 0x7f4b21ed9f90>,
<matplotlib.lines.Line2D at 0x7f4b21ede190>,
<matplotlib.lines.Line2D at 0x7f4b21ede350>,
<matplotlib.lines.Line2D at 0x7f4b21ede510>,
<matplotlib.lines.Line2D at 0x7f4b21ede6d0>,
<matplotlib.lines.Line2D at 0x7f4b21ede890>,
<matplotlib.lines.Line2D at 0x7f4b21edea50>,
<matplotlib.lines.Line2D at 0x7f4b21edec10>,
<matplotlib.lines.Line2D at 0x7f4b21ededd0>,
<matplotlib.lines.Line2D at 0x7f4b21edef90>,
<matplotlib.lines.Line2D at 0x7f4b21ee3190>,
<matplotlib.lines.Line2D at 0x7f4b21ee3350>,
<matplotlib.lines.Line2D at 0x7f4b21ee3510>,
<matplotlib.lines.Line2D at 0x7f4b21ee36d0>,
<matplotlib.lines.Line2D at 0x7f4b21ee3890>,
<matplotlib.lines.Line2D at 0x7f4b21ee3a50>,
<matplotlib.lines.Line2D at 0x7f4b21ee3b90>,
<matplotlib.lines.Line2D at 0x7f4b21ee3d50>,
<matplotlib.lines.Line2D at 0x7f4b21ee3f10>,
<matplotlib.lines.Line2D at 0x7f4b21ee6110>,
<matplotlib.lines.Line2D at 0x7f4b21ee62d0>,
<matplotlib.lines.Line2D at 0x7f4b21ee6490>,
<matplotlib.lines.Line2D at 0x7f4b21ee6650>,
<matplotlib.lines.Line2D at 0x7f4b21ee6810>,
<matplotlib.lines.Line2D at 0x7f4b21ee69d0>,
<matplotlib.lines.Line2D at 0x7f4b21ee6b90>,
<matplotlib.lines.Line2D at 0x7f4b21ee6d50>,
<matplotlib.lines.Line2D at 0x7f4b21ee6f10>,
<matplotlib.lines.Line2D at 0x7f4b21eeb110>,
<matplotlib.lines.Line2D at 0x7f4b21eeb2d0>,
<matplotlib.lines.Line2D at 0x7f4b21eeb490>,
<matplotlib.lines.Line2D at 0x7f4b21eeb650>,
<matplotlib.lines.Line2D at 0x7f4b21eeb810>,
<matplotlib.lines.Line2D at 0x7f4b21eeb9d0>,
<matplotlib.lines.Line2D at 0x7f4b21eebb90>,
<matplotlib.lines.Line2D at 0x7f4b21eebd50>,
<matplotlib.lines.Line2D at 0x7f4b21eebf10>,
<matplotlib.lines.Line2D at 0x7f4b21eee110>,
<matplotlib.lines.Line2D at 0x7f4b21eee2d0>,
<matplotlib.lines.Line2D at 0x7f4b21eee490>,
<matplotlib.lines.Line2D at 0x7f4b21eee650>,
<matplotlib.lines.Line2D at 0x7f4b21eee810>,
<matplotlib.lines.Line2D at 0x7f4b21eee9d0>,
```

```
<matplotlib.lines.Line2D at 0x7f4b21eee9d0>,
<matplotlib.lines.Line2D at 0x7f4b21eeeb90>,
<matplotlib.lines.Line2D at 0x7f4b21eeed50>,
<matplotlib.lines.Line2D at 0x7f4b21eeef10>,
<matplotlib.lines.Line2D at 0x7f4b21ef2110>,
<matplotlib.lines.Line2D at 0x7f4b21ef22d0>,
<matplotlib.lines.Line2D at 0x7f4b21ef2490>,
<matplotlib.lines.Line2D at 0x7f4b21ef2650>,
<matplotlib.lines.Line2D at 0x7f4b21ef2750>,
<matplotlib.lines.Line2D at 0x7f4b21ef2910>,
<matplotlib.lines.Line2D at 0x7f4b21ef2ad0>,
<matplotlib.lines.Line2D at 0x7f4b21ef2c90>,
<matplotlib.lines.Line2D at 0x7f4b21ef2e50>,
<matplotlib.lines.Line2D at 0x7f4b21ef2fd0>,
<matplotlib.lines.Line2D at 0x7f4b21e77210>,
<matplotlib.lines.Line2D at 0x7f4b21e773d0>,
<matplotlib.lines.Line2D at 0x7f4b21e77590>,
<matplotlib.lines.Line2D at 0x7f4b21e77750>,
<matplotlib.lines.Line2D at 0x7f4b21e77910>,
<matplotlib.lines.Line2D at 0x7f4b21e77ad0>,
<matplotlib.lines.Line2D at 0x7f4b21e77c90>,
<matplotlib.lines.Line2D at 0x7f4b21e77e50>,
<matplotlib.lines.Line2D at 0x7f4b21e77fd0>,
<matplotlib.lines.Line2D at 0x7f4b21e7b210>,
<matplotlib.lines.Line2D at 0x7f4b21e7b3d0>,
<matplotlib.lines.Line2D at 0x7f4b21e7b590>,
<matplotlib.lines.Line2D at 0x7f4b21e7b750>,
<matplotlib.lines.Line2D at 0x7f4b21e7b910>,
<matplotlib.lines.Line2D at 0x7f4b21e7bad0>,
<matplotlib.lines.Line2D at 0x7f4b21e7bc90>,
<matplotlib.lines.Line2D at 0x7f4b21e7be50>,
<matplotlib.lines.Line2D at 0x7f4b21e7bfd0>,
<matplotlib.lines.Line2D at 0x7f4b21e80210>,
<matplotlib.lines.Line2D at 0x7f4b21e803d0>,
<matplotlib.lines.Line2D at 0x7f4b21e80590>,
<matplotlib.lines.Line2D at 0x7f4b21e80750>,
<matplotlib.lines.Line2D at 0x7f4b21e80910>,
<matplotlib.lines.Line2D at 0x7f4b21e80ad0>,
<matplotlib.lines.Line2D at 0x7f4b21e80c90>,
<matplotlib.lines.Line2D at 0x7f4b21e80e50>,
<matplotlib.lines.Line2D at 0x7f4b21e80fd0>,
<matplotlib.lines.Line2D at 0x7f4b21e83210>,
<matplotlib.lines.Line2D at 0x7f4b21e833d0>,
<matplotlib.lines.Line2D at 0x7f4b21e83590>,
<matplotlib.lines.Line2D at 0x7f4b21e83750>,
<matplotlib.lines.Line2D at 0x7f4b21e83910>,
<matplotlib.lines.Line2D at 0x7f4b21e83ad0>,
<matplotlib.lines.Line2D at 0x7f4b21e83c90>,
<matplotlib.lines.Line2D at 0x7f4b21e83e50>,
<matplotlib.lines.Line2D at 0x7f4b21e83fd0>,
<matplotlib.lines.Line2D at 0x7f4b21e88210>,
<matplotlib.lines.Line2D at 0x7f4b21e883d0>,
<matplotlib.lines.Line2D at 0x7f4b21e88590>,
<matplotlib.lines.Line2D at 0x7f4b21e88750>,
<matplotlib.lines.Line2D at 0x7f4b21e88910>,
<matplotlib.lines.Line2D at 0x7f4b21e88ad0>,
<matplotlib.lines.Line2D at 0x7f4b21e88c90>,
```

```
<matplotlib.lines.Line2D at 0x7f4b21e88e50>,
<matplotlib.lines.Line2D at 0x7f4b21e88fd0>,
<matplotlib.lines.Line2D at 0x7f4b21e8d210>,
<matplotlib.lines.Line2D at 0x7f4b21e8d3d0>,
<matplotlib.lines.Line2D at 0x7f4b21e8d590>,
<matplotlib.lines.Line2D at 0x7f4b21e8d750>,
<matplotlib.lines.Line2D at 0x7f4b21e8d910>,
<matplotlib.lines.Line2D at 0x7f4b21e8dad0>,
<matplotlib.lines.Line2D at 0x7f4b21e8dc90>,
<matplotlib.lines.Line2D at 0x7f4b21e8de50>,
<matplotlib.lines.Line2D at 0x7f4b21e8dfd0>,
<matplotlib.lines.Line2D at 0x7f4b21e902d0>,
<matplotlib.lines.Line2D at 0x7f4b21e90490>,
<matplotlib.lines.Line2D at 0x7f4b21e90650>,
<matplotlib.lines.Line2D at 0x7f4b21e90810>,
<matplotlib.lines.Line2D at 0x7f4b21e909d0>,
<matplotlib.lines.Line2D at 0x7f4b21e90b90>,
<matplotlib.lines.Line2D at 0x7f4b21e90d50>,
<matplotlib.lines.Line2D at 0x7f4b21e90f10>,
<matplotlib.lines.Line2D at 0x7f4b21e96110>,
<matplotlib.lines.Line2D at 0x7f4b21e962d0>,
<matplotlib.lines.Line2D at 0x7f4b21e96490>,
<matplotlib.lines.Line2D at 0x7f4b21e96650>,
<matplotlib.lines.Line2D at 0x7f4b21e96810>,
<matplotlib.lines.Line2D at 0x7f4b21e969d0>,
<matplotlib.lines.Line2D at 0x7f4b21e96b90>,
<matplotlib.lines.Line2D at 0x7f4b21e96d50>,
<matplotlib.lines.Line2D at 0x7f4b21e96f10>,
<matplotlib.lines.Line2D at 0x7f4b21e9a110>,
<matplotlib.lines.Line2D at 0x7f4b21e9a2d0>,
<matplotlib.lines.Line2D at 0x7f4b21e9a490>,
<matplotlib.lines.Line2D at 0x7f4b21e9a650>,
<matplotlib.lines.Line2D at 0x7f4b21e9a810>,
<matplotlib.lines.Line2D at 0x7f4b21e9a9d0>,
<matplotlib.lines.Line2D at 0x7f4b21e9ab90>,
<matplotlib.lines.Line2D at 0x7f4b21e9ad50>,
<matplotlib.lines.Line2D at 0x7f4b21e9af10>,
<matplotlib.lines.Line2D at 0x7f4b21e9e110>,
<matplotlib.lines.Line2D at 0x7f4b21e9e2d0>,
<matplotlib.lines.Line2D at 0x7f4b21e9e490>,
<matplotlib.lines.Line2D at 0x7f4b21e9e650>,
<matplotlib.lines.Line2D at 0x7f4b21e9e810>,
<matplotlib.lines.Line2D at 0x7f4b21e9e9d0>,
<matplotlib.lines.Line2D at 0x7f4b21e9eb90>,
<matplotlib.lines.Line2D at 0x7f4b21e9ed50>,
<matplotlib.lines.Line2D at 0x7f4b21e9ef10>,
<matplotlib.lines.Line2D at 0x7f4b21ea2110>,
<matplotlib.lines.Line2D at 0x7f4b21ea22d0>,
<matplotlib.lines.Line2D at 0x7f4b21ea2490>,
<matplotlib.lines.Line2D at 0x7f4b21ea2650>,
<matplotlib.lines.Line2D at 0x7f4b21ea2810>,
<matplotlib.lines.Line2D at 0x7f4b21ea29d0>,
<matplotlib.lines.Line2D at 0x7f4b21ea2b90>,
<matplotlib.lines.Line2D at 0x7f4b21ea2d50>,
<matplotlib.lines.Line2D at 0x7f4b21ea2f10>,
<matplotlib.lines.Line2D at 0x7f4b21ea6110>,
<matplotlib.lines.Line2D at 0x7f4b21ea62d0>,
```

```
<matplotlib.lines.Line2D at 0x7f4b21ea62d0>,
<matplotlib.lines.Line2D at 0x7f4b21ea6490>,
<matplotlib.lines.Line2D at 0x7f4b21ea6650>,
<matplotlib.lines.Line2D at 0x7f4b21ea6810>,
<matplotlib.lines.Line2D at 0x7f4b21ea69d0>,
<matplotlib.lines.Line2D at 0x7f4b21ea6b90>,
<matplotlib.lines.Line2D at 0x7f4b21ea6d50>,
<matplotlib.lines.Line2D at 0x7f4b21ea6f10>,
<matplotlib.lines.Line2D at 0x7f4b21eab110>,
<matplotlib.lines.Line2D at 0x7f4b21eab2d0>,
<matplotlib.lines.Line2D at 0x7f4b21eab490>,
<matplotlib.lines.Line2D at 0x7f4b21eab650>,
<matplotlib.lines.Line2D at 0x7f4b21eab810>,
<matplotlib.lines.Line2D at 0x7f4b21eab9d0>,
<matplotlib.lines.Line2D at 0x7f4b21eabb90>,
<matplotlib.lines.Line2D at 0x7f4b21eabd50>,
<matplotlib.lines.Line2D at 0x7f4b21eabf10>,
<matplotlib.lines.Line2D at 0x7f4b21eaf110>,
<matplotlib.lines.Line2D at 0x7f4b21eaf2d0>,
<matplotlib.lines.Line2D at 0x7f4b21eaf490>,
<matplotlib.lines.Line2D at 0x7f4b21eaf650>,
<matplotlib.lines.Line2D at 0x7f4b2317b410>,
<matplotlib.lines.Line2D at 0x7f4b21eaf8d0>,
<matplotlib.lines.Line2D at 0x7f4b21eafa50>,
<matplotlib.lines.Line2D at 0x7f4b21eafc10>,
<matplotlib.lines.Line2D at 0x7f4b21eafdd0>,
<matplotlib.lines.Line2D at 0x7f4b21eaff90>,
<matplotlib.lines.Line2D at 0x7f4b21eb3190>,
<matplotlib.lines.Line2D at 0x7f4b21eb3350>,
<matplotlib.lines.Line2D at 0x7f4b21eb3510>,
<matplotlib.lines.Line2D at 0x7f4b21eb36d0>,
<matplotlib.lines.Line2D at 0x7f4b21eb3890>,
<matplotlib.lines.Line2D at 0x7f4b21eb3a50>,
<matplotlib.lines.Line2D at 0x7f4b21eb3c10>,
<matplotlib.lines.Line2D at 0x7f4b21eb3dd0>,
<matplotlib.lines.Line2D at 0x7f4b21eb3f90>,
<matplotlib.lines.Line2D at 0x7f4b21e38190>,
<matplotlib.lines.Line2D at 0x7f4b21e38350>,
<matplotlib.lines.Line2D at 0x7f4b21e38510>,
<matplotlib.lines.Line2D at 0x7f4b21e386d0>,
<matplotlib.lines.Line2D at 0x7f4b21e38890>,
<matplotlib.lines.Line2D at 0x7f4b21e38a50>,
<matplotlib.lines.Line2D at 0x7f4b21e38c10>,
<matplotlib.lines.Line2D at 0x7f4b21e38dd0>,
<matplotlib.lines.Line2D at 0x7f4b21e38f90>,
<matplotlib.lines.Line2D at 0x7f4b21e3c190>,
<matplotlib.lines.Line2D at 0x7f4b21e3c350>,
<matplotlib.lines.Line2D at 0x7f4b21e3c510>,
<matplotlib.lines.Line2D at 0x7f4b21e3c6d0>,
<matplotlib.lines.Line2D at 0x7f4b21e3c890>,
<matplotlib.lines.Line2D at 0x7f4b21e3ca50>,
<matplotlib.lines.Line2D at 0x7f4b21e3cc10>,
<matplotlib.lines.Line2D at 0x7f4b21e3cdd0>,
<matplotlib.lines.Line2D at 0x7f4b21e3cf90>,
<matplotlib.lines.Line2D at 0x7f4b21e40190>,
<matplotlib.lines.Line2D at 0x7f4b21e40350>,
<matplotlib.lines.Line2D at 0x7f4b21e40510>,
```

```
<matplotlib.lines.Line2D at 0x7f4b21e406d0>,
<matplotlib.lines.Line2D at 0x7f4b21e40890>,
<matplotlib.lines.Line2D at 0x7f4b21e40a50>,
<matplotlib.lines.Line2D at 0x7f4b21e40c10>,
<matplotlib.lines.Line2D at 0x7f4b21e40dd0>,
<matplotlib.lines.Line2D at 0x7f4b21e40f90>,
<matplotlib.lines.Line2D at 0x7f4b21e45190>,
<matplotlib.lines.Line2D at 0x7f4b21e45350>,
<matplotlib.lines.Line2D at 0x7f4b21e45510>,
<matplotlib.lines.Line2D at 0x7f4b21e456d0>,
<matplotlib.lines.Line2D at 0x7f4b21e45890>,
<matplotlib.lines.Line2D at 0x7f4b21e45a50>,
<matplotlib.lines.Line2D at 0x7f4b21e45c10>,
<matplotlib.lines.Line2D at 0x7f4b21e45dd0>,
<matplotlib.lines.Line2D at 0x7f4b21e45f90>,
<matplotlib.lines.Line2D at 0x7f4b21e48190>,
<matplotlib.lines.Line2D at 0x7f4b21e48350>,
<matplotlib.lines.Line2D at 0x7f4b21e48510>,
<matplotlib.lines.Line2D at 0x7f4b21e486d0>,
<matplotlib.lines.Line2D at 0x7f4b21e48890>,
<matplotlib.lines.Line2D at 0x7f4b21e48a50>,
<matplotlib.lines.Line2D at 0x7f4b21e48c10>,
<matplotlib.lines.Line2D at 0x7f4b21e48dd0>,
<matplotlib.lines.Line2D at 0x7f4b21e4d050>,
<matplotlib.lines.Line2D at 0x7f4b21e4d250>,
<matplotlib.lines.Line2D at 0x7f4b21e4d410>,
<matplotlib.lines.Line2D at 0x7f4b21e4d5d0>,
<matplotlib.lines.Line2D at 0x7f4b21e4d790>,
<matplotlib.lines.Line2D at 0x7f4b21e4d950>,
<matplotlib.lines.Line2D at 0x7f4b21e4db10>,
<matplotlib.lines.Line2D at 0x7f4b21e4dcd0>,
<matplotlib.lines.Line2D at 0x7f4b21e4de90>,
<matplotlib.lines.Line2D at 0x7f4b21e52090>,
<matplotlib.lines.Line2D at 0x7f4b21e52250>,
<matplotlib.lines.Line2D at 0x7f4b21e52410>,
<matplotlib.lines.Line2D at 0x7f4b21e525d0>,
<matplotlib.lines.Line2D at 0x7f4b21e52790>,
<matplotlib.lines.Line2D at 0x7f4b21e52950>,
<matplotlib.lines.Line2D at 0x7f4b21e52b10>,
<matplotlib.lines.Line2D at 0x7f4b21e52cd0>,
<matplotlib.lines.Line2D at 0x7f4b21e52e90>,
<matplotlib.lines.Line2D at 0x7f4b21e55090>,
<matplotlib.lines.Line2D at 0x7f4b21e55250>,
<matplotlib.lines.Line2D at 0x7f4b21e55410>,
<matplotlib.lines.Line2D at 0x7f4b21e555d0>,
<matplotlib.lines.Line2D at 0x7f4b21e55790>,
<matplotlib.lines.Line2D at 0x7f4b21e55950>,
<matplotlib.lines.Line2D at 0x7f4b21e55b10>,
<matplotlib.lines.Line2D at 0x7f4b21e55cd0>,
<matplotlib.lines.Line2D at 0x7f4b21e55e90>,
<matplotlib.lines.Line2D at 0x7f4b21e5b090>,
<matplotlib.lines.Line2D at 0x7f4b21e5b250>,
<matplotlib.lines.Line2D at 0x7f4b21e5b410>,
<matplotlib.lines.Line2D at 0x7f4b21e5b5d0>,
<matplotlib.lines.Line2D at 0x7f4b21e5b790>,
<matplotlib.lines.Line2D at 0x7f4b21e5b950>,
```

```
 <matplotlib.lines.Line2D at 0x7f4b21e5bb10>,
 <matplotlib.lines.Line2D at 0x7f4b21e5bcd0>,
 <matplotlib.lines.Line2D at 0x7f4b21e5be90>,
 <matplotlib.lines.Line2D at 0x7f4b21e60090>,
 <matplotlib.lines.Line2D at 0x7f4b21e60250>,
 <matplotlib.lines.Line2D at 0x7f4b21e60410>,
 <matplotlib.lines.Line2D at 0x7f4b21e605d0>,
 <matplotlib.lines.Line2D at 0x7f4b21e60790>,
 <matplotlib.lines.Line2D at 0x7f4b21e60950>,
 <matplotlib.lines.Line2D at 0x7f4b21e60b10>,
 <matplotlib.lines.Line2D at 0x7f4b21e60cd0>,
 <matplotlib.lines.Line2D at 0x7f4b21e60e90>,
 <matplotlib.lines.Line2D at 0x7f4b21e64090>,
 <matplotlib.lines.Line2D at 0x7f4b21e64250>,
 <matplotlib.lines.Line2D at 0x7f4b21e64410>,
 <matplotlib.lines.Line2D at 0x7f4b21e645d0>,
 <matplotlib.lines.Line2D at 0x7f4b21e64790>,
 <matplotlib.lines.Line2D at 0x7f4b21e64950>,
 <matplotlib.lines.Line2D at 0x7f4b21e64b10>,
 <matplotlib.lines.Line2D at 0x7f4b21e64cd0>,
 <matplotlib.lines.Line2D at 0x7f4b21e64e90>,
 <matplotlib.lines.Line2D at 0x7f4b21e68090>,
 <matplotlib.lines.Line2D at 0x7f4b21e68250>,
 <matplotlib.lines.Line2D at 0x7f4b21e68410>,
 <matplotlib.lines.Line2D at 0x7f4b21e685d0>,
 <matplotlib.lines.Line2D at 0x7f4b21e68790>,
 <matplotlib.lines.Line2D at 0x7f4b21e68950>,
 <matplotlib.lines.Line2D at 0x7f4b21e68b10>,
 <matplotlib.lines.Line2D at 0x7f4b21e68cd0>,
 <matplotlib.lines.Line2D at 0x7f4b21e68e90>,
 <matplotlib.lines.Line2D at 0x7f4b21e6b050>,
 <matplotlib.lines.Line2D at 0x7f4b21e6b250>,
 <matplotlib.lines.Line2D at 0x7f4b21e6b410>,
 <matplotlib.lines.Line2D at 0x7f4b21e6b5d0>,
 <matplotlib.lines.Line2D at 0x7f4b21e6b790>,
 <matplotlib.lines.Line2D at 0x7f4b21e6b950>,
 <matplotlib.lines.Line2D at 0x7f4b21e6bb10>,
 <matplotlib.lines.Line2D at 0x7f4b21e6bcd0>,
 <matplotlib.lines.Line2D at 0x7f4b21e6be90>,
 <matplotlib.lines.Line2D at 0x7f4b21e70090>,
 <matplotlib.lines.Line2D at 0x7f4b21e70250>,
 <matplotlib.lines.Line2D at 0x7f4b21e70410>,
 <matplotlib.lines.Line2D at 0x7f4b21e705d0>,
 <matplotlib.lines.Line2D at 0x7f4b21e70790>,
 <matplotlib.lines.Line2D at 0x7f4b21e70950>,
 <matplotlib.lines.Line2D at 0x7f4b21e70b10>,
 <matplotlib.lines.Line2D at 0x7f4b21e70cd0>,
 <matplotlib.lines.Line2D at 0x7f4b21e70e90>,
 <matplotlib.lines.Line2D at 0x7f4b21df5090>,
 <matplotlib.lines.Line2D at 0x7f4b21df5250>,
 <matplotlib.lines.Line2D at 0x7f4b21df5410>,
 <matplotlib.lines.Line2D at 0x7f4b231d3e50>,
 <matplotlib.lines.Line2D at 0x7f4b21df56d0>,
 <matplotlib.lines.Line2D at 0x7f4b21df5890>,
 <matplotlib.lines.Line2D at 0x7f4b21df5a50>,
 <matplotlib.lines.Line2D at 0x7f4b21df5c10>,
 <matplotlib.lines.Line2D at 0x7f4b21df5dd0>,
```

```
<matplotlib.lines.Line2D at 0x7f4b21df5f90>,
<matplotlib.lines.Line2D at 0x7f4b21df9190>,
<matplotlib.lines.Line2D at 0x7f4b21df9350>,
<matplotlib.lines.Line2D at 0x7f4b21df9510>,
<matplotlib.lines.Line2D at 0x7f4b21df96d0>,
<matplotlib.lines.Line2D at 0x7f4b21df9890>,
<matplotlib.lines.Line2D at 0x7f4b21df9a50>,
<matplotlib.lines.Line2D at 0x7f4b21df9c10>,
<matplotlib.lines.Line2D at 0x7f4b21df9dd0>,
<matplotlib.lines.Line2D at 0x7f4b21df9f90>,
<matplotlib.lines.Line2D at 0x7f4b21dfd190>,
<matplotlib.lines.Line2D at 0x7f4b21dfd350>,
<matplotlib.lines.Line2D at 0x7f4b21dfd510>,
<matplotlib.lines.Line2D at 0x7f4b21dfd6d0>,
<matplotlib.lines.Line2D at 0x7f4b21dfd890>,
<matplotlib.lines.Line2D at 0x7f4b21dfda50>,
<matplotlib.lines.Line2D at 0x7f4b21dfdc10>,
<matplotlib.lines.Line2D at 0x7f4b21dfddd0>,
<matplotlib.lines.Line2D at 0x7f4b21dfdf90>,
<matplotlib.lines.Line2D at 0x7f4b21e01190>,
<matplotlib.lines.Line2D at 0x7f4b21e01350>,
<matplotlib.lines.Line2D at 0x7f4b21e01510>,
<matplotlib.lines.Line2D at 0x7f4b21e016d0>,
<matplotlib.lines.Line2D at 0x7f4b21e01890>,
<matplotlib.lines.Line2D at 0x7f4b21e01a50>,
<matplotlib.lines.Line2D at 0x7f4b21e01c10>,
<matplotlib.lines.Line2D at 0x7f4b21e01dd0>,
<matplotlib.lines.Line2D at 0x7f4b21e01f90>,
<matplotlib.lines.Line2D at 0x7f4b21e06190>,
<matplotlib.lines.Line2D at 0x7f4b21e06350>,
<matplotlib.lines.Line2D at 0x7f4b21e06510>,
<matplotlib.lines.Line2D at 0x7f4b21e066d0>,
<matplotlib.lines.Line2D at 0x7f4b21e06890>,
<matplotlib.lines.Line2D at 0x7f4b21e06a50>,
<matplotlib.lines.Line2D at 0x7f4b21e06c10>,
<matplotlib.lines.Line2D at 0x7f4b21e06dd0>,
<matplotlib.lines.Line2D at 0x7f4b21e06f90>,
<matplotlib.lines.Line2D at 0x7f4b21e0a190>,
<matplotlib.lines.Line2D at 0x7f4b21e0a350>,
<matplotlib.lines.Line2D at 0x7f4b21e0a510>,
<matplotlib.lines.Line2D at 0x7f4b21e0a6d0>,
<matplotlib.lines.Line2D at 0x7f4b21e0a890>,
<matplotlib.lines.Line2D at 0x7f4b21e0aa50>,
<matplotlib.lines.Line2D at 0x7f4b21e0ac10>,
<matplotlib.lines.Line2D at 0x7f4b21e0add0>,
<matplotlib.lines.Line2D at 0x7f4b21e0af90>,
<matplotlib.lines.Line2D at 0x7f4b21e0e190>,
<matplotlib.lines.Line2D at 0x7f4b21e0e350>,
<matplotlib.lines.Line2D at 0x7f4b21e0e510>,
<matplotlib.lines.Line2D at 0x7f4b21e0e6d0>,
<matplotlib.lines.Line2D at 0x7f4b21e0e890>,
<matplotlib.lines.Line2D at 0x7f4b21e0eb10>,
<matplotlib.lines.Line2D at 0x7f4b21e0ecd0>,
<matplotlib.lines.Line2D at 0x7f4b21e0ee90>,
<matplotlib.lines.Line2D at 0x7f4b21e13090>,
<matplotlib.lines.Line2D at 0x7f4b21e13250>,
```

```
<matplotlib.lines.Line2D at 0x7f4b21e13410>,
<matplotlib.lines.Line2D at 0x7f4b21e135d0>,
<matplotlib.lines.Line2D at 0x7f4b21e13790>,
<matplotlib.lines.Line2D at 0x7f4b21e13950>,
<matplotlib.lines.Line2D at 0x7f4b21e13b10>,
<matplotlib.lines.Line2D at 0x7f4b21e13cd0>,
<matplotlib.lines.Line2D at 0x7f4b21e13e90>,
<matplotlib.lines.Line2D at 0x7f4b21e18090>,
<matplotlib.lines.Line2D at 0x7f4b21e18250>,
<matplotlib.lines.Line2D at 0x7f4b21e18410>,
<matplotlib.lines.Line2D at 0x7f4b21e185d0>,
<matplotlib.lines.Line2D at 0x7f4b21e18790>,
<matplotlib.lines.Line2D at 0x7f4b21e18950>,
<matplotlib.lines.Line2D at 0x7f4b21e18b10>,
<matplotlib.lines.Line2D at 0x7f4b21e18cd0>,
<matplotlib.lines.Line2D at 0x7f4b21e18e90>,
<matplotlib.lines.Line2D at 0x7f4b21e1b090>,
<matplotlib.lines.Line2D at 0x7f4b21e1b250>,
<matplotlib.lines.Line2D at 0x7f4b21e1b410>,
<matplotlib.lines.Line2D at 0x7f4b21e1b5d0>,
<matplotlib.lines.Line2D at 0x7f4b21e1b790>,
<matplotlib.lines.Line2D at 0x7f4b21e1b950>,
<matplotlib.lines.Line2D at 0x7f4b21e1bb10>,
<matplotlib.lines.Line2D at 0x7f4b21e1bcd0>,
<matplotlib.lines.Line2D at 0x7f4b21e1be90>,
<matplotlib.lines.Line2D at 0x7f4b21e20090>,
<matplotlib.lines.Line2D at 0x7f4b21e20250>,
<matplotlib.lines.Line2D at 0x7f4b21e20410>,
<matplotlib.lines.Line2D at 0x7f4b21e205d0>,
<matplotlib.lines.Line2D at 0x7f4b21e20790>,
<matplotlib.lines.Line2D at 0x7f4b21e20950>,
<matplotlib.lines.Line2D at 0x7f4b21e20b10>,
<matplotlib.lines.Line2D at 0x7f4b21e20cd0>,
<matplotlib.lines.Line2D at 0x7f4b21e20e90>,
<matplotlib.lines.Line2D at 0x7f4b21e23090>,
<matplotlib.lines.Line2D at 0x7f4b21e23250>,
<matplotlib.lines.Line2D at 0x7f4b21e23410>,
<matplotlib.lines.Line2D at 0x7f4b21e235d0>,
<matplotlib.lines.Line2D at 0x7f4b21e23790>,
<matplotlib.lines.Line2D at 0x7f4b21e23950>,
<matplotlib.lines.Line2D at 0x7f4b21e23b10>,
<matplotlib.lines.Line2D at 0x7f4b21e23cd0>,
<matplotlib.lines.Line2D at 0x7f4b21e23e90>,
<matplotlib.lines.Line2D at 0x7f4b21e28050>,
<matplotlib.lines.Line2D at 0x7f4b21e28250>,
<matplotlib.lines.Line2D at 0x7f4b21e28410>,
<matplotlib.lines.Line2D at 0x7f4b21e285d0>,
<matplotlib.lines.Line2D at 0x7f4b21e28790>,
<matplotlib.lines.Line2D at 0x7f4b21e28950>,
<matplotlib.lines.Line2D at 0x7f4b21e28b10>,
<matplotlib.lines.Line2D at 0x7f4b21e28cd0>,
<matplotlib.lines.Line2D at 0x7f4b21e28e90>,
<matplotlib.lines.Line2D at 0x7f4b21e2d090>,
<matplotlib.lines.Line2D at 0x7f4b21e2d250>,
<matplotlib.lines.Line2D at 0x7f4b21e2d410>,
<matplotlib.lines.Line2D at 0x7f4b21e2d5d0>,
<matplotlib.lines.Line2D at 0x7f4b21e48f90>,
```
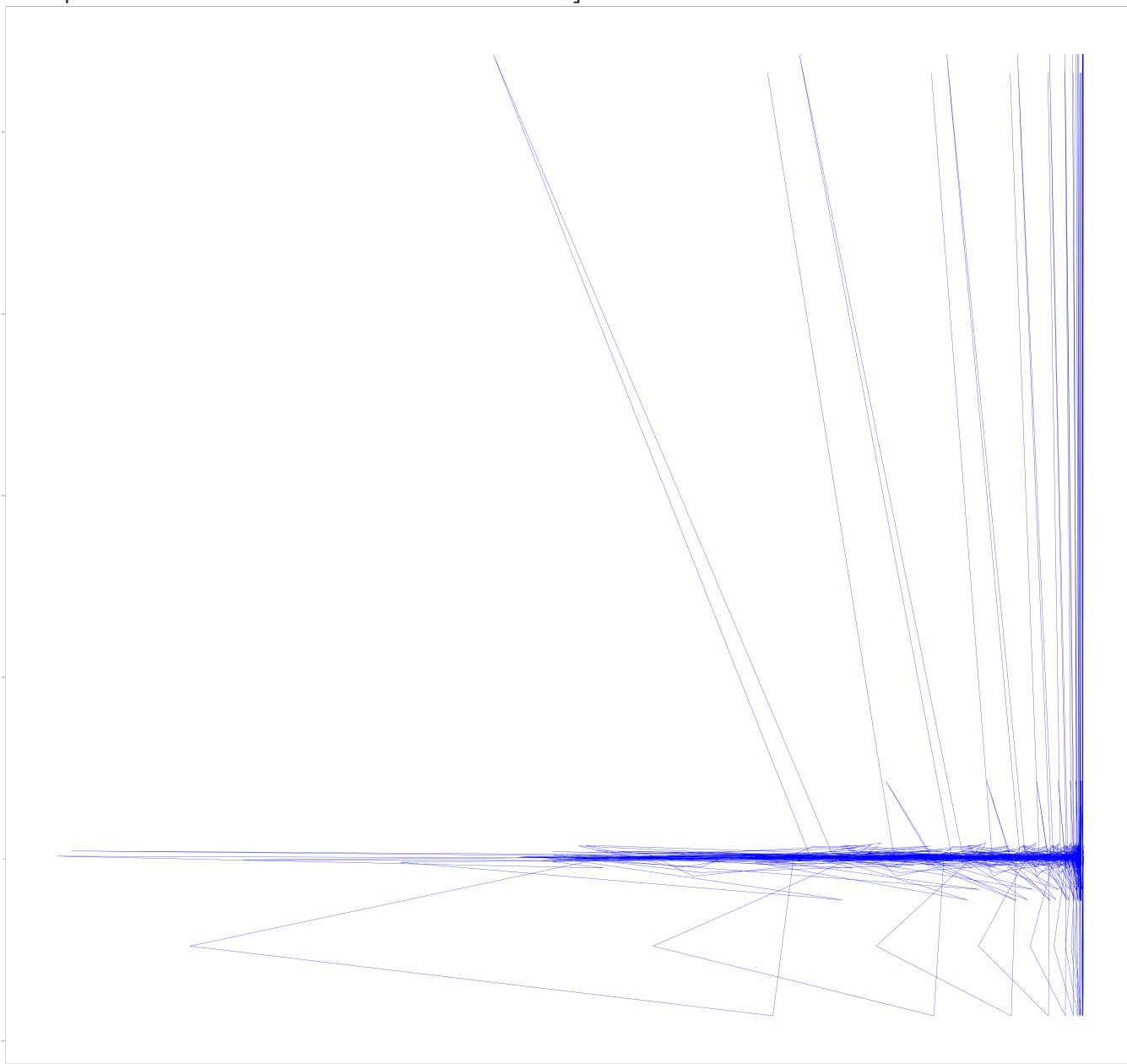
```
<matplotlib.lines.Line2D at 0x7f4b21e2d890>,
<matplotlib.lines.Line2D at 0x7f4b21e2da50>,
<matplotlib.lines.Line2D at 0x7f4b21e2dc10>,
<matplotlib.lines.Line2D at 0x7f4b21e2ddd0>,
<matplotlib.lines.Line2D at 0x7f4b21e2df90>,
<matplotlib.lines.Line2D at 0x7f4b21e31190>,
<matplotlib.lines.Line2D at 0x7f4b21e31350>,
<matplotlib.lines.Line2D at 0x7f4b21e31510>,
<matplotlib.lines.Line2D at 0x7f4b21e316d0>,
<matplotlib.lines.Line2D at 0x7f4b21e31890>,
<matplotlib.lines.Line2D at 0x7f4b21e31a50>,
<matplotlib.lines.Line2D at 0x7f4b21e31c10>,
<matplotlib.lines.Line2D at 0x7f4b21e31dd0>,
<matplotlib.lines.Line2D at 0x7f4b21e31f90>,
<matplotlib.lines.Line2D at 0x7f4b21db6190>,
<matplotlib.lines.Line2D at 0x7f4b21db6350>,
<matplotlib.lines.Line2D at 0x7f4b21db6510>,
<matplotlib.lines.Line2D at 0x7f4b21db66d0>,
<matplotlib.lines.Line2D at 0x7f4b21db6890>,
<matplotlib.lines.Line2D at 0x7f4b21db6a50>,
<matplotlib.lines.Line2D at 0x7f4b21db6c10>,
<matplotlib.lines.Line2D at 0x7f4b21db6dd0>,
<matplotlib.lines.Line2D at 0x7f4b21db6f90>,
<matplotlib.lines.Line2D at 0x7f4b21db9190>,
<matplotlib.lines.Line2D at 0x7f4b21db9350>,
<matplotlib.lines.Line2D at 0x7f4b21db9510>,
<matplotlib.lines.Line2D at 0x7f4b21db96d0>,
<matplotlib.lines.Line2D at 0x7f4b21db9890>,
<matplotlib.lines.Line2D at 0x7f4b21db9a50>,
<matplotlib.lines.Line2D at 0x7f4b21db9c10>,
<matplotlib.lines.Line2D at 0x7f4b21db9dd0>,
<matplotlib.lines.Line2D at 0x7f4b21db9f90>,
<matplotlib.lines.Line2D at 0x7f4b21dbe190>,
<matplotlib.lines.Line2D at 0x7f4b21dbe350>,
<matplotlib.lines.Line2D at 0x7f4b21dbe510>,
<matplotlib.lines.Line2D at 0x7f4b21dbe6d0>,
<matplotlib.lines.Line2D at 0x7f4b21dbe890>,
<matplotlib.lines.Line2D at 0x7f4b21dbea50>,
<matplotlib.lines.Line2D at 0x7f4b21dbec10>,
<matplotlib.lines.Line2D at 0x7f4b21dbedd0>,
<matplotlib.lines.Line2D at 0x7f4b21dbef90>,
<matplotlib.lines.Line2D at 0x7f4b21dc2190>,
<matplotlib.lines.Line2D at 0x7f4b21dc2350>,
<matplotlib.lines.Line2D at 0x7f4b21dc2510>,
<matplotlib.lines.Line2D at 0x7f4b21dc26d0>,
<matplotlib.lines.Line2D at 0x7f4b21dc2890>,
<matplotlib.lines.Line2D at 0x7f4b21dc2a50>,
<matplotlib.lines.Line2D at 0x7f4b21dc2c10>,
<matplotlib.lines.Line2D at 0x7f4b21dc2dd0>,
<matplotlib.lines.Line2D at 0x7f4b21dc2f90>,
<matplotlib.lines.Line2D at 0x7f4b21dc6190>,
<matplotlib.lines.Line2D at 0x7f4b21dc6350>,
<matplotlib.lines.Line2D at 0x7f4b21dc6510>,
<matplotlib.lines.Line2D at 0x7f4b21dc66d0>,
<matplotlib.lines.Line2D at 0x7f4b21dc6890>,
<matplotlib.lines.Line2D at 0x7f4b21dc6a50>,
```

```
        <matplotlib.lines.Line2D at 0x7f4b21dc6c10>,
        <matplotlib.lines.Line2D at 0x7f4b21dc6dd0>,
        <matplotlib.lines.Line2D at 0x7f4b21dc6f90>,
        <matplotlib.lines.Line2D at 0x7f4b21dcb190>,
        <matplotlib.lines.Line2D at 0x7f4b21dcb410>,
        <matplotlib.lines.Line2D at 0x7f4b21dcb5d0>,
        <matplotlib.lines.Line2D at 0x7f4b21dcb790>,
        <matplotlib.lines.Line2D at 0x7f4b21dcb950>,
        <matplotlib.lines.Line2D at 0x7f4b21dcbb10>,
        <matplotlib.lines.Line2D at 0x7f4b21dcbcd0>,
        <matplotlib.lines.Line2D at 0x7f4b21dcbe90>,
        <matplotlib.lines.Line2D at 0x7f4b21dcf090>,
        <matplotlib.lines.Line2D at 0x7f4b21dcf250>,
        <matplotlib.lines.Line2D at 0x7f4b21dcf410>,
        <matplotlib.lines.Line2D at 0x7f4b21dcf5d0>,
        <matplotlib.lines.Line2D at 0x7f4b21dcf790>,
        <matplotlib.lines.Line2D at 0x7f4b21dcf950>,
        <matplotlib.lines.Line2D at 0x7f4b21dcfb10>,
        <matplotlib.lines.Line2D at 0x7f4b21dcfcd0>,
        <matplotlib.lines.Line2D at 0x7f4b21dcfe90>,
        <matplotlib.lines.Line2D at 0x7f4b21dd3090>,
        <matplotlib.lines.Line2D at 0x7f4b21dd3250>,
        <matplotlib.lines.Line2D at 0x7f4b21dd3410>,
        <matplotlib.lines.Line2D at 0x7f4b21dd35d0>,
        <matplotlib.lines.Line2D at 0x7f4b21dd3790>,
        <matplotlib.lines.Line2D at 0x7f4b21dd3950>,
        <matplotlib.lines.Line2D at 0x7f4b21dd3b10>,
        <matplotlib.lines.Line2D at 0x7f4b21dd3cd0>,
        <matplotlib.lines.Line2D at 0x7f4b21dd3e90>,
        <matplotlib.lines.Line2D at 0x7f4b21dd9090>,
        <matplotlib.lines.Line2D at 0x7f4b21dd9250>,
        <matplotlib.lines.Line2D at 0x7f4b21dd9410>,
        <matplotlib.lines.Line2D at 0x7f4b21dd95d0>,
        <matplotlib.lines.Line2D at 0x7f4b21dd9790>,
        <matplotlib.lines.Line2D at 0x7f4b21dd9950>,
        <matplotlib.lines.Line2D at 0x7f4b21dd9b10>,
        <matplotlib.lines.Line2D at 0x7f4b21dd9cd0>,
        <matplotlib.lines.Line2D at 0x7f4b21dd9e90>,
        <matplotlib.lines.Line2D at 0x7f4b21dde090>,
        <matplotlib.lines.Line2D at 0x7f4b21dde250>,
        <matplotlib.lines.Line2D at 0x7f4b21dde410>,
        <matplotlib.lines.Line2D at 0x7f4b21dde5d0>,
        <matplotlib.lines.Line2D at 0x7f4b21dde790>,
        <matplotlib.lines.Line2D at 0x7f4b21dde950>,
        <matplotlib.lines.Line2D at 0x7f4b21ddeb10>,
        <matplotlib.lines.Line2D at 0x7f4b21ddecd0>,
        <matplotlib.lines.Line2D at 0x7f4b21ddee90>,
        <matplotlib.lines.Line2D at 0x7f4b21de1090>,
        <matplotlib.lines.Line2D at 0x7f4b21de1250>,
        <matplotlib.lines.Line2D at 0x7f4b21de1410>,
        <matplotlib.lines.Line2D at 0x7f4b21de15d0>,
        <matplotlib.lines.Line2D at 0x7f4b21de1790>,
        <matplotlib.lines.Line2D at 0x7f4b21de1950>,
        <matplotlib.lines.Line2D at 0x7f4b21de1b10>,
        <matplotlib.lines.Line2D at 0x7f4b21de1cd0>,
        <matplotlib.lines.Line2D at 0x7f4b21de1e90>,
        <matplotlib.lines.Line2D at 0x7f4b21de5050>
```

```
<matplotlib.lines.Line2D at 0x7f4b21de5050>,
<matplotlib.lines.Line2D at 0x7f4b21de5250>,
<matplotlib.lines.Line2D at 0x7f4b21de5410>,
<matplotlib.lines.Line2D at 0x7f4b21de55d0>,
<matplotlib.lines.Line2D at 0x7f4b207f07d0>,
<matplotlib.lines.Line2D at 0x7f4b21de5a50>,
<matplotlib.lines.Line2D at 0x7f4b21de5c50>,
<matplotlib.lines.Line2D at 0x7f4b21de58d0>,
<matplotlib.lines.Line2D at 0x7f4b21de5f10>,
<matplotlib.lines.Line2D at 0x7f4b21de5950>,
<matplotlib.lines.Line2D at 0x7f4b21ded1d0>,
<matplotlib.lines.Line2D at 0x7f4b21ded390>,
<matplotlib.lines.Line2D at 0x7f4b21ded550>,
<matplotlib.lines.Line2D at 0x7f4b21ded710>,
<matplotlib.lines.Line2D at 0x7f4b21ded8d0>,
<matplotlib.lines.Line2D at 0x7f4b21deda90>,
<matplotlib.lines.Line2D at 0x7f4b21dedc50>,
<matplotlib.lines.Line2D at 0x7f4b21dede10>,
<matplotlib.lines.Line2D at 0x7f4b21dedfd0>,
<matplotlib.lines.Line2D at 0x7f4b21dee1d0>,
<matplotlib.lines.Line2D at 0x7f4b21dee390>,
<matplotlib.lines.Line2D at 0x7f4b21dee550>,
<matplotlib.lines.Line2D at 0x7f4b21dee750>,
<matplotlib.lines.Line2D at 0x7f4b21dee8d0>,
<matplotlib.lines.Line2D at 0x7f4b21deea10>,
<matplotlib.lines.Line2D at 0x7f4b21deec50>,
<matplotlib.lines.Line2D at 0x7f4b21deee10>,
<matplotlib.lines.Line2D at 0x7f4b21deefd0>,
<matplotlib.lines.Line2D at 0x7f4b21df31d0>,
<matplotlib.lines.Line2D at 0x7f4b21df3310>,
<matplotlib.lines.Line2D at 0x7f4b21df3550>,
<matplotlib.lines.Line2D at 0x7f4b21df3710>,
<matplotlib.lines.Line2D at 0x7f4b21df38d0>,
<matplotlib.lines.Line2D at 0x7f4b21df3a90>,
<matplotlib.lines.Line2D at 0x7f4b21df3c90>,
<matplotlib.lines.Line2D at 0x7f4b21df3e10>,
<matplotlib.lines.Line2D at 0x7f4b21df3fd0>,
<matplotlib.lines.Line2D at 0x7f4b21d761d0>,
<matplotlib.lines.Line2D at 0x7f4b21d76390>,
<matplotlib.lines.Line2D at 0x7f4b21d76550>,
<matplotlib.lines.Line2D at 0x7f4b21d76710>,
<matplotlib.lines.Line2D at 0x7f4b21d768d0>,
<matplotlib.lines.Line2D at 0x7f4b21d76a90>,
<matplotlib.lines.Line2D at 0x7f4b21d76c50>,
<matplotlib.lines.Line2D at 0x7f4b21d76e10>,
<matplotlib.lines.Line2D at 0x7f4b21d76fd0>,
<matplotlib.lines.Line2D at 0x7f4b21d7b1d0>,
<matplotlib.lines.Line2D at 0x7f4b21d7b390>,
<matplotlib.lines.Line2D at 0x7f4b21d7b550>,
<matplotlib.lines.Line2D at 0x7f4b21d7b710>,
<matplotlib.lines.Line2D at 0x7f4b21d7b8d0>,
<matplotlib.lines.Line2D at 0x7f4b21d7ba90>,
<matplotlib.lines.Line2D at 0x7f4b21d7bc50>,
<matplotlib.lines.Line2D at 0x7f4b21d7be10>,
<matplotlib.lines.Line2D at 0x7f4b21d7bfd0>,
<matplotlib.lines.Line2D at 0x7f4b21d801d0>,
<matplotlib.lines.Line2D at 0x7f4b21d80390>,
```

```
     <matplotlib.lines.Line2D at 0x7f4b21d80550>,
     <matplotlib.lines.Line2D at 0x7f4b21d80710>,
     <matplotlib.lines.Line2D at 0x7f4b21d808d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d80a90>,
     <matplotlib.lines.Line2D at 0x7f4b21d80c50>,
     <matplotlib.lines.Line2D at 0x7f4b21d80e10>,
     <matplotlib.lines.Line2D at 0x7f4b21d80fd0>,
     <matplotlib.lines.Line2D at 0x7f4b21d841d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d84390>,
     <matplotlib.lines.Line2D at 0x7f4b249351d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d84710>,
     <matplotlib.lines.Line2D at 0x7f4b21d848d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d84a90>,
     <matplotlib.lines.Line2D at 0x7f4b21d84c50>,
     <matplotlib.lines.Line2D at 0x7f4b21d84e10>,
     <matplotlib.lines.Line2D at 0x7f4b21d84fd0>,
     <matplotlib.lines.Line2D at 0x7f4b21d891d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d89390>,
     <matplotlib.lines.Line2D at 0x7f4b21d89550>,
     <matplotlib.lines.Line2D at 0x7f4b21d89710>,
     <matplotlib.lines.Line2D at 0x7f4b21d898d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d89a90>,
     <matplotlib.lines.Line2D at 0x7f4b21d89c50>,
     <matplotlib.lines.Line2D at 0x7f4b21d89e10>,
     <matplotlib.lines.Line2D at 0x7f4b21d89fd0>,
     <matplotlib.lines.Line2D at 0x7f4b21d8d1d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d8d390>,
     <matplotlib.lines.Line2D at 0x7f4b21d8d550>,
     <matplotlib.lines.Line2D at 0x7f4b21d8d710>,
     <matplotlib.lines.Line2D at 0x7f4b21d8d8d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d8da90>,
     <matplotlib.lines.Line2D at 0x7f4b21d8dc50>,
     <matplotlib.lines.Line2D at 0x7f4b21d8de10>,
     <matplotlib.lines.Line2D at 0x7f4b21d8dfd0>,
     <matplotlib.lines.Line2D at 0x7f4b21d911d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d91390>,
     <matplotlib.lines.Line2D at 0x7f4b21d91550>,
     <matplotlib.lines.Line2D at 0x7f4b21d91710>,
     <matplotlib.lines.Line2D at 0x7f4b21d918d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d91a90>,
     <matplotlib.lines.Line2D at 0x7f4b21d91c50>,
     <matplotlib.lines.Line2D at 0x7f4b21d91e10>,
     <matplotlib.lines.Line2D at 0x7f4b21d91fd0>,
     <matplotlib.lines.Line2D at 0x7f4b21d951d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d95390>,
     <matplotlib.lines.Line2D at 0x7f4b21d95550>,
     <matplotlib.lines.Line2D at 0x7f4b21d95710>,
     <matplotlib.lines.Line2D at 0x7f4b21d958d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d95a90>,
     <matplotlib.lines.Line2D at 0x7f4b21d95c50>,
     <matplotlib.lines.Line2D at 0x7f4b21d95e10>,
     <matplotlib.lines.Line2D at 0x7f4b21d95fd0>,
     <matplotlib.lines.Line2D at 0x7f4b21d9a1d0>,
     <matplotlib.lines.Line2D at 0x7f4b21d9a390>,
     <matplotlib.lines.Line2D at 0x7f4b21d9a550>,
     <matplotlib.lines.Line2D at 0x7f4b21d9a710>,
     <matplotlib.lines.Line2D at 0x7f4b21d9a8d0>,
```

```
<matplotlib.lines.Line2D at 0x7f4b21d9a8d0>,
<matplotlib.lines.Line2D at 0x7f4b21d9aa90>,
<matplotlib.lines.Line2D at 0x7f4b21d9ac50>,
<matplotlib.lines.Line2D at 0x7f4b21d9ae10>,
<matplotlib.lines.Line2D at 0x7f4b21d9afd0>,
<matplotlib.lines.Line2D at 0x7f4b21d9e1d0>,
<matplotlib.lines.Line2D at 0x7f4b21d9e390>,
<matplotlib.lines.Line2D at 0x7f4b21d9e550>,
<matplotlib.lines.Line2D at 0x7f4b21d9e710>,
<matplotlib.lines.Line2D at 0x7f4b21d9e8d0>,
<matplotlib.lines.Line2D at 0x7f4b21d9ea90>,
<matplotlib.lines.Line2D at 0x7f4b21d9ec50>,
<matplotlib.lines.Line2D at 0x7f4b21d9ee10>,
<matplotlib.lines.Line2D at 0x7f4b21d9efd0>,
<matplotlib.lines.Line2D at 0x7f4b21da21d0>,
<matplotlib.lines.Line2D at 0x7f4b21da2450>,
<matplotlib.lines.Line2D at 0x7f4b21da2610>,
<matplotlib.lines.Line2D at 0x7f4b21da27d0>,
<matplotlib.lines.Line2D at 0x7f4b21da2990>,
<matplotlib.lines.Line2D at 0x7f4b21da2b50>]
```
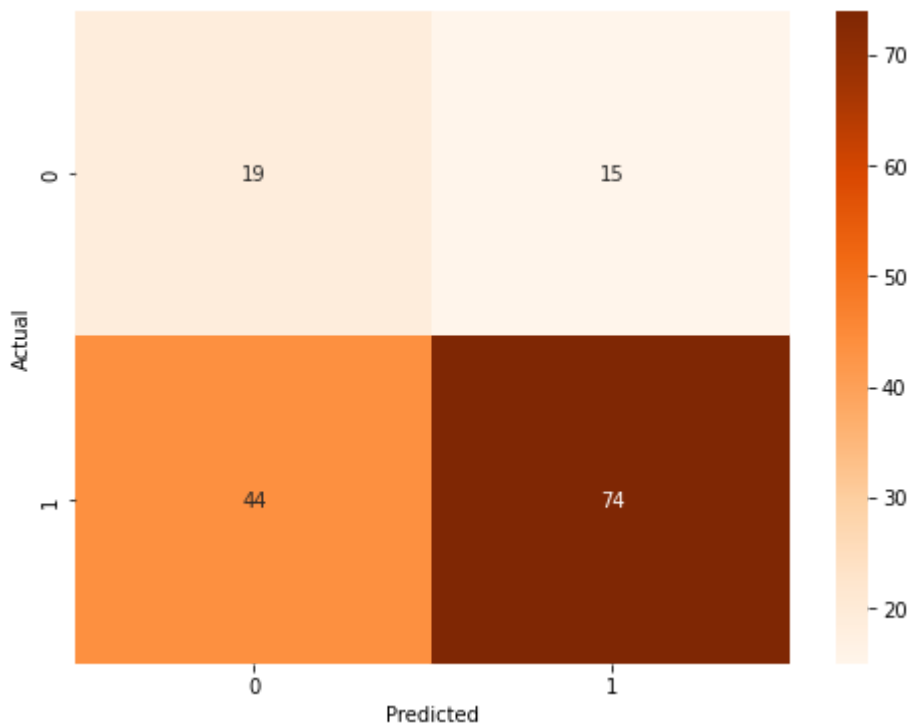
```python
from sklearn.metrics import confusion_matrix

import matplotlib.pyplot as plt

cm = confusion_matrix(Y_test, predictions_model1)
import seaborn as sns
plt.figure(figsize = (8,6))
fg = sns.heatmap(cm,annot=True,cmap='Oranges')
figure = fg.get_figure()
plt.xlabel("Predicted")
plt.ylabel("Actual")
```

```
Text(51.0, 0.5, 'Actual')
```



```python
tp, fn, fp, tn = cm.ravel()

precision = tp / ( tp + fp )
recall =  tp / ( tp + fn )
fiscore=2*(precision*recall)/(precision+recall)

print('precision -', precision)
print('recall -', recall)
print('fi_score -',fiscore)
```

```
precision - 0.30158730158730157
recall - 0.5588235294117647
```

```
fi_score - 0.39175257731958757
```

▾ MODEL 2 - LOGISTIC REGRESSION

```
from sklearn.linear_model import LogisticRegression
```

```
model2= LogisticRegression()
```

```
model2.fit(X_train,Y_train)
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/linear_model/_logistic.py:818: Convergenc
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG,
LogisticRegression()
```

```
Y_predmod2 = model2.predict(X_test)
```

```
Y_predmod2
```

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

```
Y_test
```

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

```
print('Logistic Regression Accuracy:')
```

```
model2.score(X_test,Y_test)
```

```
Logistic Regression Accuracy:
0.756578947368421
```

```
from sklearn.metrics import confusion_matrix
```

```
cm=confusion_matrix(Y_test,Y_predmod2)
import seaborn as sn
plt.figure (figsize=(8,6))
sn.heatmap(cm, annot=True)
plt.xlabel("Predicted")
plt.ylabel("Truth")
```

```
Text(51.0, 0.5, 'Truth')
```



```
tp, fn, fp, tn = cm.ravel()
```

```
precision = tp / ( tp + fp )
recall =  tp / ( tp + fn )
fiscore=2*(precision*recall)/(precision+recall)
```
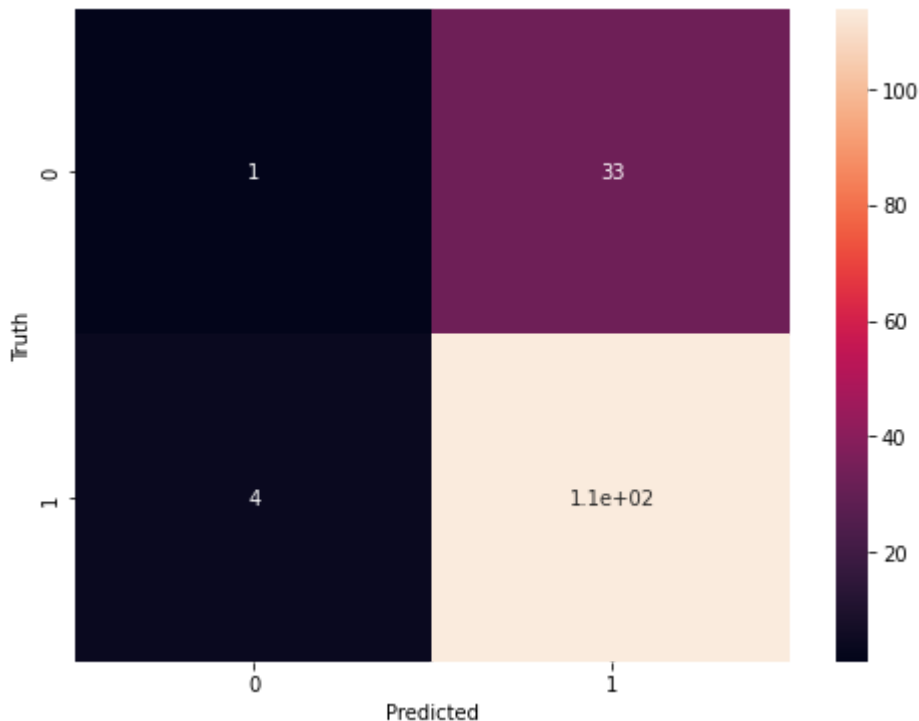
```
print('precision -', precision)
print('recall -', recall)
print('fi_score -',fiscore)
```

```
precision - 0.2
recall - 0.029411764705882353
fi_score - 0.05128205128205128
```

▾ MODEL 3 - DECISION TREE

```
from sklearn import tree

model3=tree.DecisionTreeClassifier()

model3.fit(X_train,Y_train)
```

```
    DecisionTreeClassifier()
```

```
Y_predmod3=model3.predict(X_test)
Y_predmod3
```

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

```
Y_test
```

```
    array([1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1,
           1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1,
           0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1,
           0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 1,
           0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1,
           1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1,
           1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1])
```
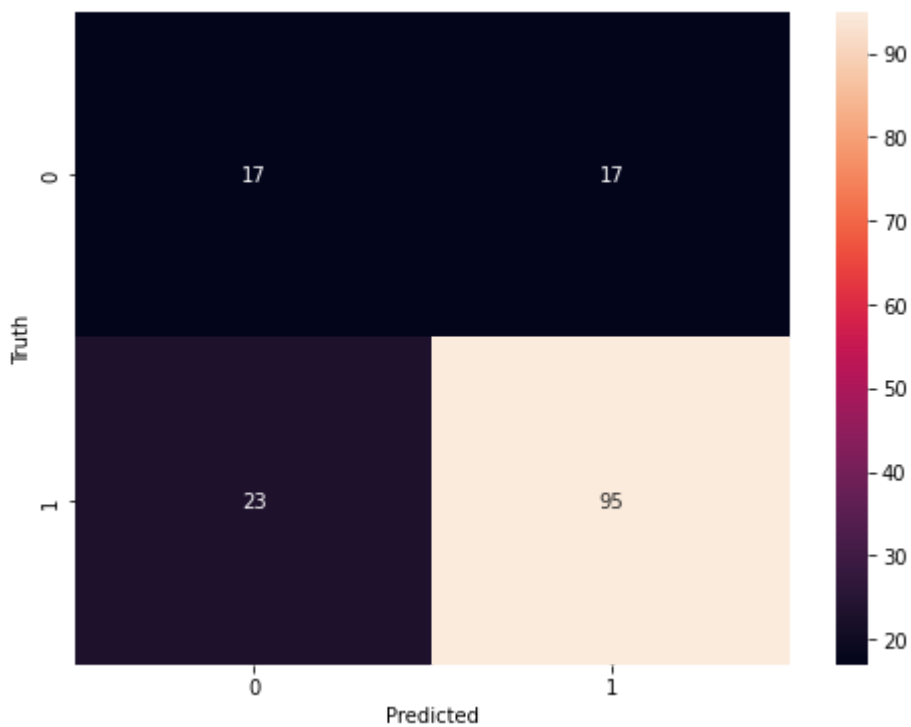
```
print('Decision tree Accuracy:')
model3.score(X_test,Y_test)
```

```
    Decision tree Accuracy:
    0.7368421052631579
```
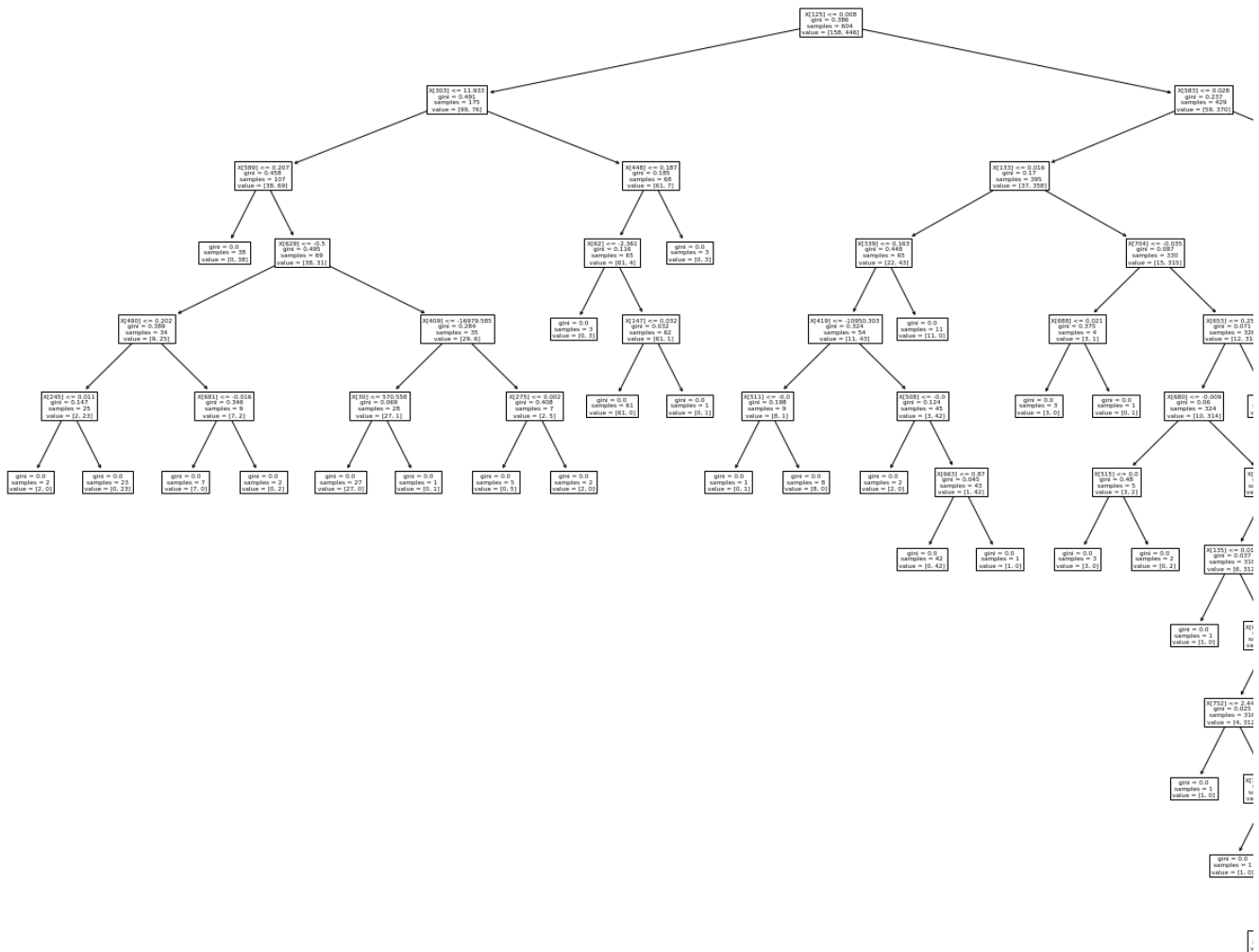
```
cm=confusion_matrix(Y_test,Y_predmod3)
import seaborn as sn
plt.figure (figsize=(8,6))
sn.heatmap(cm, annot=True)
```

```
plt.xlabel("Predicted")
plt.ylabel("Truth")
```

Text(51.0, 0.5, 'Truth')


```
fig=plt.figure(figsize=(25,20))
_=tree.plot_tree(model3)
```

```
tp, fn, fp, tn = cm.ravel()

precision = tp / ( tp + fp )
recall =   tp / ( tp + fn )
fiscore=2*(precision*recall)/(precision+recall)

print('precision -', precision)
print('recall -', recall)
print('fi_score -',fiscore)
```

```
    precision - 0.425
    recall - 0.5
    fi_score - 0.45945945945945943
```