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Principles of Datascience

This is a difficult regression task, where the aim is to predict the burned area of forest fires, in the northeast region of Portugal, by using meteorological and other data.

In [132…

```
import numpy as np
import pandas as pd
import matplotlib as mpl
import matplotlib.pyplot as plt
%matplotlib inline
import ffmpeg

from matplotlib.animation import FuncAnimation
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler

import wandb

import warnings
warnings.filterwarnings(action='ignore')
```

Loading the data

In [133…
```
forestdata = pd.read_csv("http://www.dsi.uminho.pt/~pcortez/forestfires/forestfires.csv")
forestdata
```

Out[133…

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
0	7	5	mar	fri	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	0.00
1	7	4	oct	tue	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	0.00
2	7	4	oct	sat	90.6	43.7	686.9	6.7	14.6	33	1.3	0.0	0.00
3	8	6	mar	fri	91.7	33.3	77.5	9.0	8.3	97	4.0	0.2	0.00
4	8	6	mar	sun	89.3	51.3	102.2	9.6	11.4	99	1.8	0.0	0.00
...	...	...	...	...	...	...	...	...	...	...	...	...	...
512	4	3	aug	sun	81.6	56.7	665.6	1.9	27.8	32	2.7	0.0	6.44
513	2	4	aug	sun	81.6	56.7	665.6	1.9	21.9	71	5.8	0.0	54.29
514	7	4	aug	sun	81.6	56.7	665.6	1.9	21.2	70	6.7	0.0	11.16
515	1	4	aug	sat	94.4	146.0	614.7	11.3	25.6	42	4.0	0.0	0.00
516	6	3	nov	tue	79.5	3.0	106.7	1.1	11.8	31	4.5	0.0	0.00

517 rows × 13 columns

In [134…
```
#Cleaning the data and checking for null values
forestdata.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 517 entries, 0 to 516
Data columns (total 13 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   X       517 non-null    int64  
 1   Y       517 non-null    int64  
 2   month   517 non-null    object 
 3   day     517 non-null    object 
 4   FFMC    517 non-null    float64
 5   DMC     517 non-null    float64
 6   DC      517 non-null    float64
 7   ISI     517 non-null    float64
 8   temp    517 non-null    float64
```

```
 9   RH      517 non-null    int64
 10  wind    517 non-null    float64
 11  rain    517 non-null    float64
 12  area    517 non-null    float64
dtypes: float64(8), int64(3), object(2)
memory usage: 52.6+ KB
```

'temp' has the highest correlation with the area of forest fire(which is a positive correlation), followed by 'RH' also a positive correlation, 'Rain' has the least correlation

'Wind', 'RH' and 'DMC' were top 3 selected features/feature combination for predicting 'Area' using Recursive Feature Elimination, the 2nd selected feature was atually one of the attributes with the highest correlation with the 'Area

In [135…
```
forestdata.isnull()
```

Out[135…

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
0	False	False	False	False	False	False	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False	False	False	False	False	False
...	...	...	...	...	...	...	...	...	...	...	...	...	...
512	False	False	False	False	False	False	False	False	False	False	False	False	False
513	False	False	False	False	False	False	False	False	False	False	False	False	False
514	False	False	False	False	False	False	False	False	False	False	False	False	False

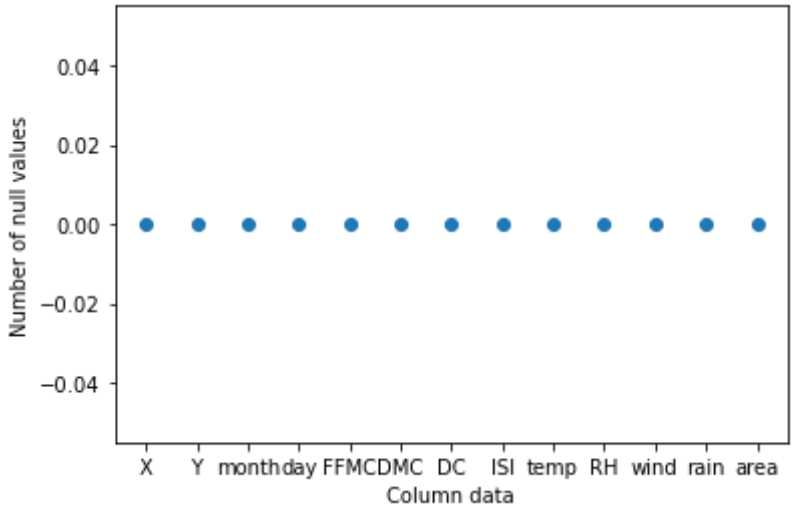
	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
515	False	False	False	False	False	False	False	False	False	False	False	False	False
516	False	False	False	False	False	False	False	False	False	False	False	False	False

517 rows × 13 columns

In [136…
```
forestdata.isnull().sum()
```

Out[136…
```
X        0
Y        0
month    0
day      0
FFMC     0
DMC      0
DC       0
ISI      0
temp     0
RH       0
wind     0
rain     0
area     0
dtype: int64
```

In [137…
```
plt.scatter(forestdata.columns.values, forestdata.isnull().sum().values,  cmap="viridis")
plt.xlabel('Column data')
plt.ylabel('Number of null values')
plt.show()
```



In [138…
```
forestdata.shape
```

Out[138…
```
(517, 13)
```

In [139…
```
forestdata.columns
```

Out[139…
```
Index(['X', 'Y', 'month', 'day', 'FFMC', 'DMC', 'DC', 'ISI', 'temp', 'RH',
       'wind', 'rain', 'area'],
      dtype='object')
```

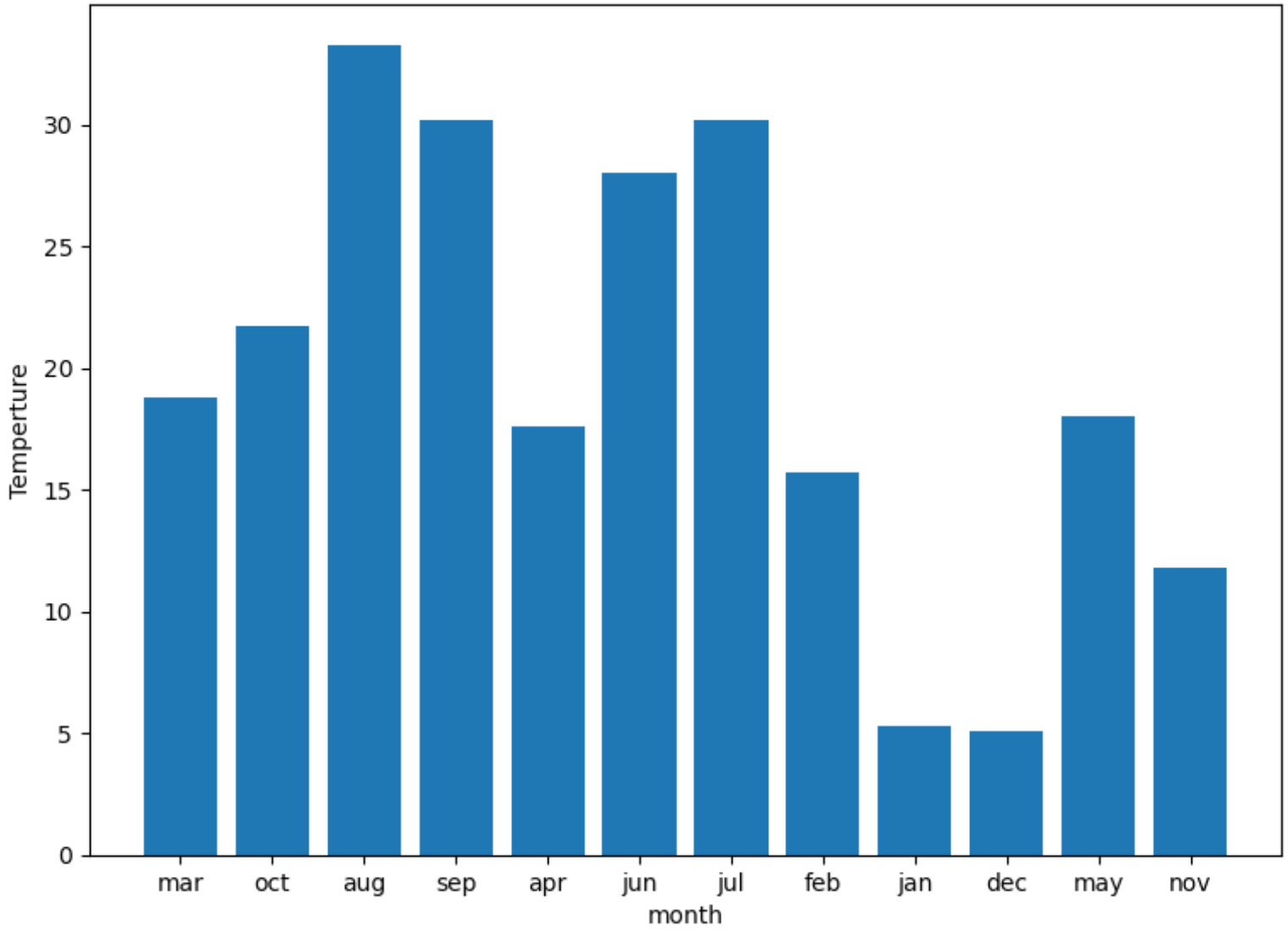
In [140…
```
forestdata['day']
```

Out[140…
```
0      fri
1      tue
2      sat
3      fri
4      sun
      ...
512    sun
513    sun
514    sun
515    sat
516    tue
Name: day, Length: 517, dtype: object
```

In [141…

```
fig = plt.figure(figsize=(7,5),dpi=100)
axes = fig.add_axes([0,0,1,1])
x1 = np.array(forestdata['month'])
y1 = np.array(forestdata['temp'])

axes.bar(forestdata['month'], forestdata['temp'])
axes.set_xlabel('month')
axes.set_ylabel('Temperture')
plt.show()
```



In [142…
```
forestdata['day'] = forestdata['day'].replace(['sun','mon','tue','wed','thu','fri','sat'], [1,2,3,4,5,6,7])
```

In [143…
```
forestdata['month'] = forestdata['month'].replace(['jan','feb','mar','apr','may','jun','jul','aug','sep','oct','nov',
```

In [ ]:

In [144…
```
forestdata['day']
```

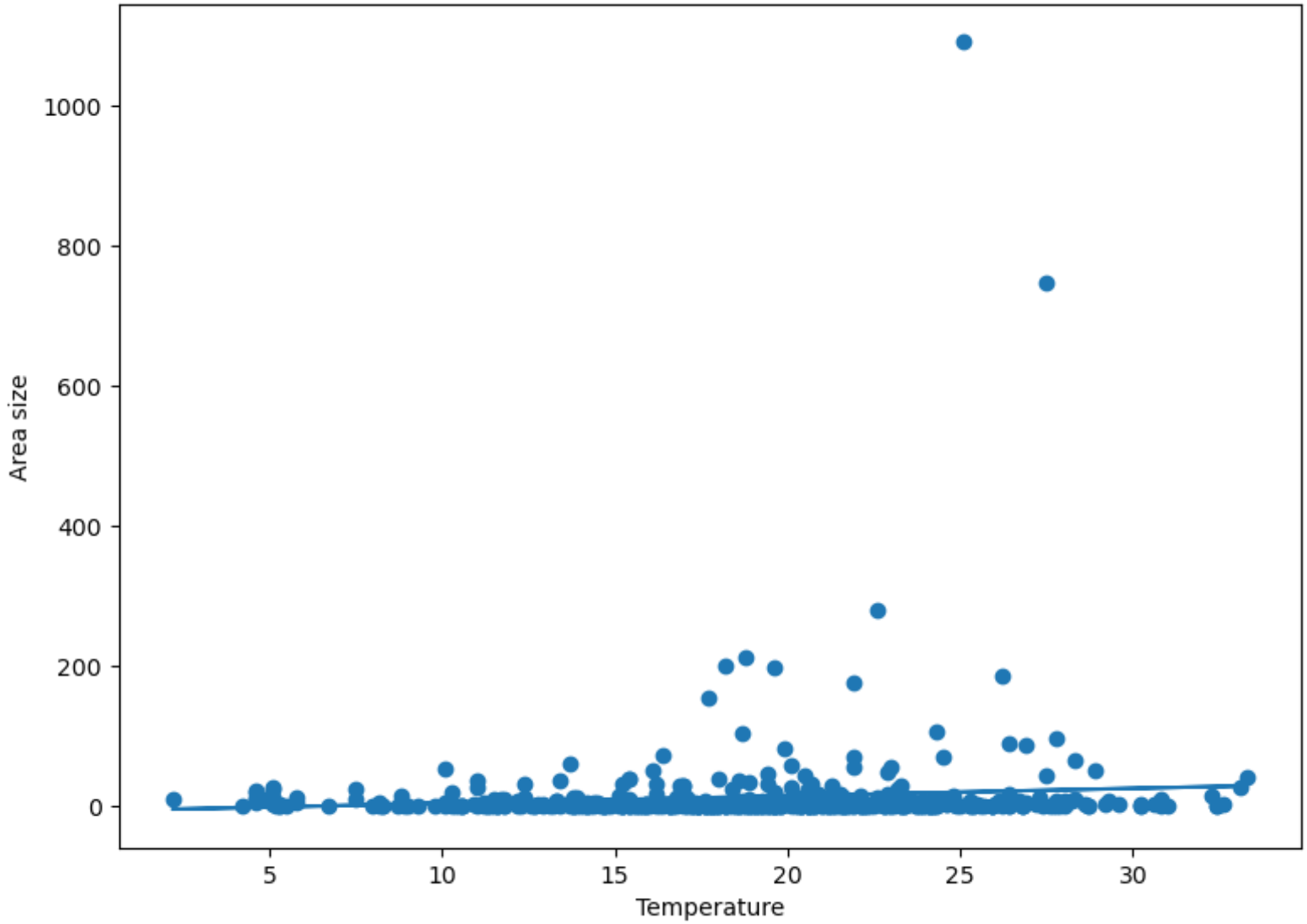
Out[144…
```
0      6
1      3
2      7
3      6
4      1
      ..
512    1
513    1
514    1
515    7
516    3
Name: day, Length: 517, dtype: int64
```

In [145…
```
forestdata['month']
```

Out[145…
```
0       3
1      10
2      10
3       3
4       3
       ..
512     8
513     8
514     8
515     8
516    11
Name: month, Length: 517, dtype: int64
```

In [146…
```
fig = plt.figure(figsize=(7,5),dpi=100)
axes = fig.add_axes([0,0,1,1])
x1 = np.array(forestdata['temp'])
y1 = np.array(forestdata['area'])

m, b = np.polyfit(x1, y1, 1)
plt.plot(x1, m*x1 + b)
axes.scatter(forestdata['temp'], forestdata['area'])
axes.set_xlabel('Temperature')
axes.set_ylabel('Area size')
plt.show()
```

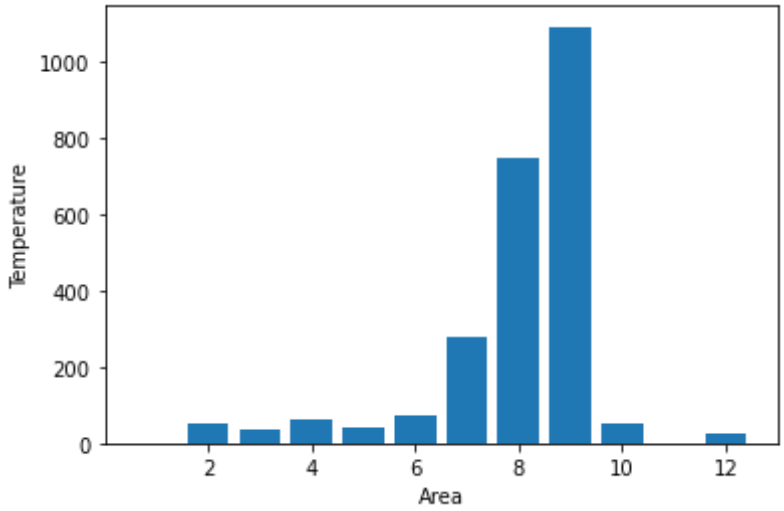


In [ ]:

In [147…

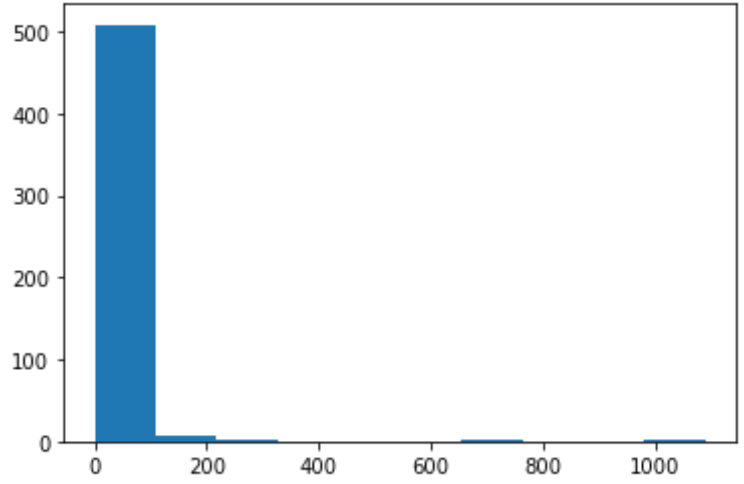
```
plt.bar(forestdata.month, forestdata.area)
plt.xlabel('Area')
plt.ylabel('Temperature')
```

```
plt.show()
```



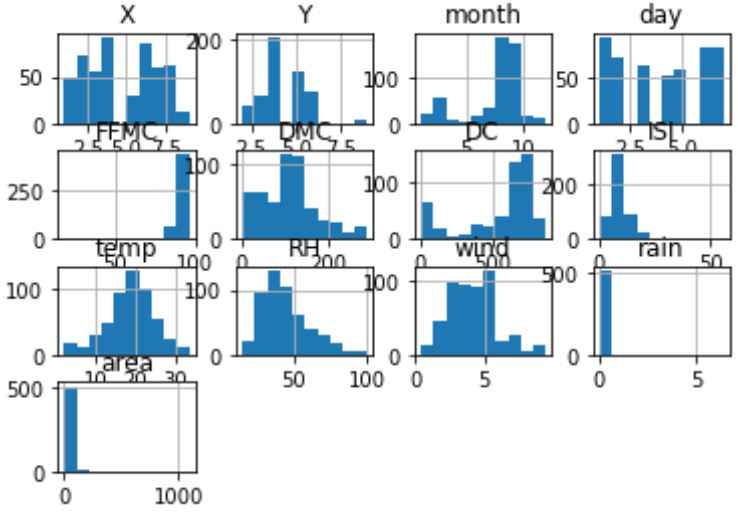
In [148…
```
plt.hist((forestdata.area))
```

Out[148…
```
(array([508.,   6.,   1.,   0.,   0.,   0.,   1.,   0.,   0.,   1.]),
 array([   0.   ,  109.084,  218.168,  327.252,  436.336,  545.42 ,
         654.504,  763.588,  872.672,  981.756, 1090.84 ]),
 <BarContainer object of 10 artists>)
```



In [149…
```
forestdata.hist()
```

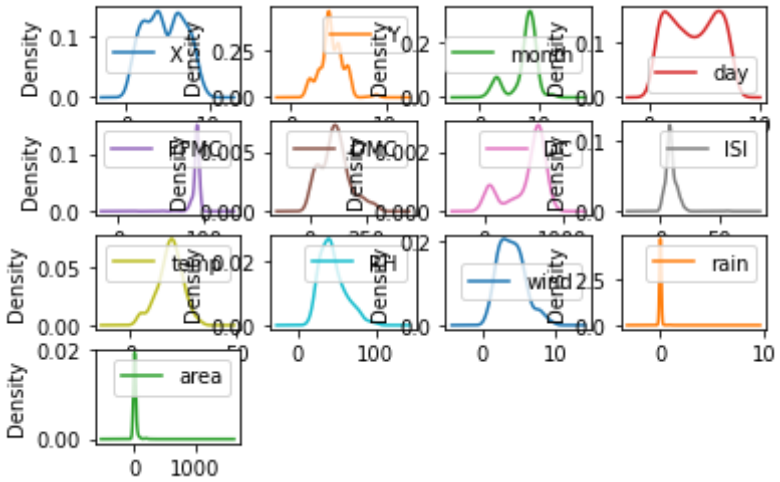
Out[149…
```
array([[<AxesSubplot:title={'center':'X'}>,
        <AxesSubplot:title={'center':'Y'}>,
        <AxesSubplot:title={'center':'month'}>,
        <AxesSubplot:title={'center':'day'}>],
       [<AxesSubplot:title={'center':'FFMC'}>,
        <AxesSubplot:title={'center':'DMC'}>,
        <AxesSubplot:title={'center':'DC'}>,
        <AxesSubplot:title={'center':'ISI'}>],
       [<AxesSubplot:title={'center':'temp'}>,
        <AxesSubplot:title={'center':'RH'}>,
        <AxesSubplot:title={'center':'wind'}>,
        <AxesSubplot:title={'center':'rain'}>],
       [<AxesSubplot:title={'center':'area'}>, <AxesSubplot:>,
        <AxesSubplot:>, <AxesSubplot:>]], dtype=object)
```



In [150…
```
forestdata.plot(kind='density', subplots=True, layout=(4,4), sharex=False, sharey=False)
```

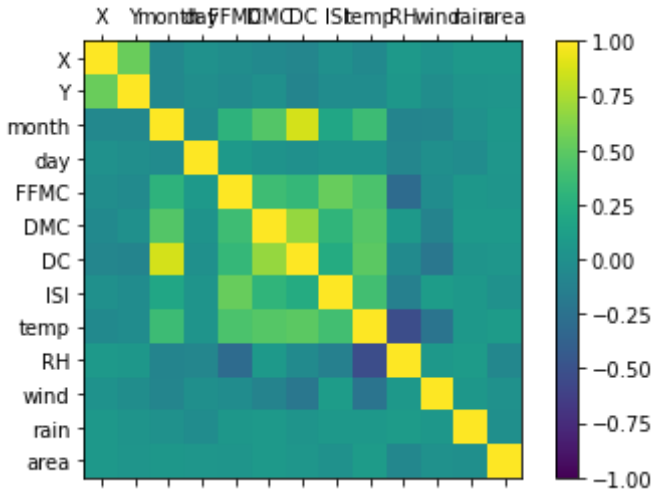
Out[150…
```
array([[<AxesSubplot:ylabel='Density'>, <AxesSubplot:ylabel='Density'>,
        <AxesSubplot:ylabel='Density'>, <AxesSubplot:ylabel='Density'>],
       [<AxesSubplot:ylabel='Density'>, <AxesSubplot:ylabel='Density'>,
        <AxesSubplot:ylabel='Density'>, <AxesSubplot:ylabel='Density'>],
       [<AxesSubplot:ylabel='Density'>, <AxesSubplot:ylabel='Density'>,
        <AxesSubplot:ylabel='Density'>, <AxesSubplot:ylabel='Density'>],
       [<AxesSubplot:ylabel='Density'>, <AxesSubplot:ylabel='Density'>,
```

```
  <AxesSubplot:ylabel='Density'>, <AxesSubplot:ylabel='Density'>]],
dtype=object)
```



In [151…
```
fig = plt.figure()
ax = fig.add_subplot(111)
cax = ax.matshow(forestdata.corr(), vmin=-1, vmax=1)
fig.colorbar(cax)
ticks = np.arange(0,13,1)
ax.set_xticks(ticks)
ax.set_yticks(ticks)
ax.set_xticklabels(forestdata.columns)
ax.set_yticklabels(forestdata.columns)
```

Out[151…
```
[Text(0, 0, 'X'),
 Text(0, 1, 'Y'),
 Text(0, 2, 'month'),
 Text(0, 3, 'day'),
 Text(0, 4, 'FFMC'),
 Text(0, 5, 'DMC'),
 Text(0, 6, 'DC'),
 Text(0, 7, 'ISI'),
 Text(0, 8, 'temp'),
 Text(0, 9, 'RH'),
 Text(0, 10, 'wind'),
 Text(0, 11, 'rain'),
 Text(0, 12, 'area')]
```



In [152…
```
forestdata.describe()
```

Out[152…

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	
count	517.000000	517.000000	517.000000	517.000000	517.000000	517.000000	517.000000	517.000000	517.000000	517.000000	517.000000	517.00
mean	4.669246	4.299807	7.475822	3.972921	90.644681	110.872340	547.940039	9.021663	18.889168	44.288201	4.017602	0.02
std	2.313778	1.229900	2.275990	2.143867	5.520111	64.046482	248.066192	4.559477	5.806625	16.317469	1.791653	0.29
min	1.000000	2.000000	1.000000	1.000000	18.700000	1.100000	7.900000	0.000000	2.200000	15.000000	0.400000	0.00
25%	3.000000	4.000000	7.000000	2.000000	90.200000	68.600000	437.700000	6.500000	15.500000	33.000000	2.700000	0.00
50%	4.000000	4.000000	8.000000	4.000000	91.600000	108.300000	664.200000	8.400000	19.300000	42.000000	4.000000	0.00
75%	7.000000	5.000000	9.000000	6.000000	92.900000	142.400000	713.900000	10.800000	22.800000	53.000000	4.900000	0.00
max	9.000000	9.000000	12.000000	7.000000	96.200000	291.300000	860.600000	56.100000	33.300000	100.000000	9.400000	6.40

In [153…
```
forestdata
```

Out[153…

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
0	7	5	3	6	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	0.00

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
1	7	4	10	3	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	0.00
2	7	4	10	7	90.6	43.7	686.9	6.7	14.6	33	1.3	0.0	0.00
3	8	6	3	6	91.7	33.3	77.5	9.0	8.3	97	4.0	0.2	0.00
4	8	6	3	1	89.3	51.3	102.2	9.6	11.4	99	1.8	0.0	0.00
...	...	...	...	...	...	...	...	...	...	...	...	...	...
512	4	3	8	1	81.6	56.7	665.6	1.9	27.8	32	2.7	0.0	6.44
513	2	4	8	1	81.6	56.7	665.6	1.9	21.9	71	5.8	0.0	54.29
514	7	4	8	1	81.6	56.7	665.6	1.9	21.2	70	6.7	0.0	11.16
515	1	4	8	7	94.4	146.0	614.7	11.3	25.6	42	4.0	0.0	0.00
516	6	3	11	3	79.5	3.0	106.7	1.1	11.8	31	4.5	0.0	0.00

517 rows × 13 columns

In [154…
```
X = forestdata.iloc[:, 0:12].values.astype(int)
y = forestdata.iloc[:,12].values.astype(int)
```

In [155…
```
X
```

Out[155…
```
array([[ 7,  5,  3, ..., 51,  6,  0],
       [ 7,  4, 10, ..., 33,  0,  0],
       [ 7,  4, 10, ..., 33,  1,  0],
       ...,
       [ 7,  4,  8, ..., 70,  6,  0],
       [ 1,  4,  8, ..., 42,  4,  0],
       [ 6,  3, 11, ..., 31,  4,  0]])
```

In [156…
```
y
```

Out[156…
```
array([   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,    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,    1,    1,    1,    1,    1,    1,
 1,    1,    1,    1,    1,    1,    1,    1,    1,    1,    2,
 2,    2,    2,    2,    2,    2,    2,    2,    3,    3,    4,
 4,    4,    4,    5,    5,    5,    6,    6,    6,    7,    7,
 7,    7,    8,    8,    8,    8,    9,   10,   10,   10,   11,
11,   11,   11,   12,   13,   13,   13,   14,   15,   17,   19,
23,   24,   26,   26,   27,   28,   28,   29,   30,   31,   31,
32,   35,   36,   37,   37,   48,   49,   58,   64,   71,   88,
95,  103,  105,  154,  196,  200,  212, 1090,    0,    0,    0,
10,    0,    2,    0,    0,    0,    0,    2,    0,    0,    0,
 1,   10,    0,    8,    0,    0,    1,    8,    3,    4,    1,
 6,    0,    0,    0,    0,    4,    0,    9,    3,    8,   11,
 5,   17,   10,   22,    9,    9,   24,    0,    1,   24,    0,
 0,    0,    0,    0,    0,    8,    2,   86,    6,    0,    0,
 0,    0,    0,    0,    3,    0,    0,    0,    0,    0,    5,
 0,    0,    0,   14,    0,    0,    1,    0,    0,    3,    0,
 4,   34,    7,    1,    2,    4,    0,    0,    0,    0,    3,
 6,   15,   11,    2,    0,    0,    0,   56,    7,    1,    3,
 0,    0,    2,    6,    5,   28,    0,    0,    1,    3,    7,
 2,    1,    5,   13,    1,    0,    0,    8,    1,    3,    0,
 2,    5,   20,    1,    0,   12,    0,   11,    0,    0,    0,
18,   39,    0,  174,    0,    0,    7,   16,    5,   42,   12,
16,   24,    0,   28,    0,    9,   30,   70,    0,    0,   51,
 3,    3,    0,    0,    8,    4,    0,    0,    6,    0,    3,
 0,    7,    0,    0,    4,    1,    0,    0,  746,    7,    0,
 2,    3,  185,    0,    6,    0,    4,    0,    0,    2,    0,
 3,    0,    6,    0,   15,    0,    0,    0,    0,    6,    0,
 0,    1,    3,    0,    9,    0,    0,    0,    0,    0,    6,
 9,    0,    0,    0,    0,    0,   82,    3,    1,    0,    0,
 3,    5,    2,    6,    3,    5,    6,   61,    0,   38,    1,
70,   10,    3,    1,    7,    2,  278,    2,    0,    1,    0,
26,    2,    2,   16,   46,    0,    0,    0,    0,   43,    8,
 0,    2,   14,   40,   10,    0,    0,    0,    1,   49,    5,
 0,    0,    0,    2,    0,    0,    6,   54,   11,    0,    0])
```

In [ ]:

Encoding Categorical Data

In [157…

```
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
from sklearn.compose import ColumnTransformer
from sklearn import utils
from sklearn import preprocessing

labelencoder_X1 = LabelEncoder()
X[:, 2] = labelencoder_X1.fit_transform(X[:, 2]) #For month
print(X[:, 2] )
print("\n")


labelencoder_X2 = preprocessing.LabelEncoder()
X[:, 3] = labelencoder_X2.fit_transform(X[:, 3]) #For weekday
print(X[:, 3] )
print("\n")


#onehotenc    oder = OneHotEncoder(categorical_features = [2])#dummy variable for month
#X = onehotencoder.fit_transform(X).toarray()
#X = X[:, 1:]

columnTransformer = ColumnTransformer([('encoder', OneHotEncoder(), [2])], remainder = 'passthrough')
X = np.array(columnTransformer.fit_transform(X), dtype = np.int64)
X = X[:, 1:]

#onehotencoder = OneHotEncoder(categorical_features = [13])#dummy variable for week
#X = onehotencoder.fit_transform(X).toarray()
#X = X[:, 1:]

columnTransformer = ColumnTransformer([('encoder', OneHotEncoder(), [13])], remainder = 'passthrough')
X = np.array(columnTransformer.fit_transform(X), dtype = np.int64)
X = X[:, 1:]

print(X)
print(utils.multiclass.type_of_target(X))
print(utils.multiclass.type_of_target(X.astype('int')))
print(utils.multiclass.type_of_target(X))
```

```
[ 2  9  9  2  2  7  7  7  8  8  8  8  7  8  8  8  2  9  2  3  8  8  5  7
  7  7  8  8  8  8  8  8  8  8  8  8  9  9  9  2  6  7  7  8  8  8  8  6
  2  2  8  7  7  7  7  8  8  9  1  1  2  2  7  7  7  7  8  8  8  2  2  8
  2  7  8  1  1  2  7  7  7  7  7  7  7  8  8  8  8  2  7  2  7  7  7  8
  1  2  7  7  7  7  7  8  0  2  2  7  8  8  2  2  8  8  2  2  2  2  2  7
  7  7  8  8  8  9  2  8  9  9  1  2  2  8  2  7  8  8  6  8  8  7  7  6
  7  7  2  8  7  8  5  6  6  8  8  7  8  7  7  8  2  7  2  8  8  2  7  7
  2  7  8  7  7  8  7  7  3  7  8  7  8  9  1  9  7  8  2  8  2  2  2  7
  7  8  7  7  3  8  8  8  8  2  1  9  2  8  7  8  8  8  9  7  8  2  2  2
  8  8  8  2  7  8  2  6  8  8  9  7  8  7  8  8  8  8  8  8  7  8  8  8  3
  3  3  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
  7  7  7  7  7  7  7  7  7 11 11 11 11 11 11 11 11 11  1  1  1  6  6  6
  6  6  6  6  6  6  6  5  5  5  5  5  5  5  5  5  4  8  8  8  8  8  8  8
  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
  8  8  8  8  8  8  8  8  8  8  8  6  7  7  8  8  7  7  2  0  6  7  7  7
  7  7  8  2  7  7  1  8  8  2  1  1  8  7  7  5  5  8  7  7  8  7  8  1
  8  6  1  1  6  7  7  7  6  2  7  7  7  7  6  8  7  7  7  7  7  7  8  7
  7  7  7  6  7  7  7  8  8  7  3  6  8  7  7  2  8  7  7  7  7  7  7  6
  7  7  7  7  7  7  8  1  1  1  2  2  2  3  3  4  5  5  5  5  6  6  6  6
  6  6  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
  7  7  7  7  7  7  7  7  7  7  7  7 10]
```

```
[5 2 6 5 0 0 1 1 2 6 6 6 5 1 3 5 6 1 3 6 2 1 0 6 6 0 5 1 6 0 5 1 5 0 1 2 2
 5 6 2 2 6 2 6 3 3 1 1 1 1 4 0 3 3 4 4 2 0 1 5 0 0 4 0 1 4 5 5 5 5 5 5 5 2
 5 4 5 1 5 2 0 0 2 3 4 4 4 4 0 6 6 5 0 0 1 0 6 6 0 0 0 2 2 6 6 5 4 0 6 1 5
 5 0 1 2 2 6 6 1 4 1 1 0 2 5 0 1 5 3 0 6 1 0 4 2 6 0 1 2 2 1 3 5 6 3 4 1 2
 2 4 5 0 6 5 6 0 6 3 3 5 1 4 6 6 0 4 3 3 5 4 3 3 0 1 6 6 4 0 3 2 0 1 0 1 5
 2 0 1 6 0 5 4 2 3 2 5 4 4 2 1 2 0 0 3 6 4 6 2 5 4 6 6 5 1 6 6 0 1 3 1 0 5
 1 5 3 0 1 6 0 6 3 0 2 2 6 0 6 2 6 0 3 5 0 0 0 0 0 3 3 3 3 3 3 4 4 4 6 6 6
 6 1 5 5 5 5 2 2 2 2 2 2 2 2 0 3 4 1 1 1 1 5 2 0 3 5 0 3 6 6 6 6 6 5 2 2 0
 0 0 3 6 1 1 5 5 6 0 0 0 0 0 0 0 0 3 3 3 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 2 2 2 2 2 6 0
 0 3 0 4 5 6 1 6 4 0 3 4 3 4 6 0 0 4 5 5 1 5 0 2 1 0 0 0 6 3 3 4 5 4 3 2 6
 6 5 2 5 5 1 6 0 4 2 3 0 0 3 3 0 6 6 4 4 1 4 0 4 6 4 0 5 6 1 6 6 5 5 1 1 5
 5 0 0 3 3 0 3 5 1 4 4 1 4 3 6 6 6 6 0 2 2 6 1 3 4 0 0 5 1 6 4 4 4 0 0 1 4
 4 0 0 0 1 2 2 2 3 3 4 5 5 6 1 1 2 2 2 2 2 2 3 3 4 5 5 5 5 5 0 0 0 0 6 2]
```

```
[[ 0  0  0 ... 51  6  0]
 [ 0  1  0 ... 33  0  0]
 [ 0  0  0 ... 33  1  0]
 ...
 [ 0  0  0 ... 70  6  0]
```

```
 [ 0  0  0 ... 42  4  0]
 [ 0  1  0 ... 31  4  0]]
multiclass-multioutput
multiclass-multioutput
multiclass-multioutput
```

In [158…
```
forestdata
```

Out[158…

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
0	7	5	3	6	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	0.00
1	7	4	10	3	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	0.00
2	7	4	10	7	90.6	43.7	686.9	6.7	14.6	33	1.3	0.0	0.00
3	8	6	3	6	91.7	33.3	77.5	9.0	8.3	97	4.0	0.2	0.00
4	8	6	3	1	89.3	51.3	102.2	9.6	11.4	99	1.8	0.0	0.00
...	...	...	...	...	...	...	...	...	...	...	...	...	...
512	4	3	8	1	81.6	56.7	665.6	1.9	27.8	32	2.7	0.0	6.44
513	2	4	8	1	81.6	56.7	665.6	1.9	21.9	71	5.8	0.0	54.29
514	7	4	8	1	81.6	56.7	665.6	1.9	21.2	70	6.7	0.0	11.16
515	1	4	8	7	94.4	146.0	614.7	11.3	25.6	42	4.0	0.0	0.00
516	6	3	11	3	79.5	3.0	106.7	1.1	11.8	31	4.5	0.0	0.00

517 rows × 13 columns

Train and Test

In [159…
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test= train_test_split(X,y,test_size=0.2, random_state=15)
```

In [160…
```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

In [161…
```
X_train[:,0]
```

Out[161…
```
array([-0.38783737, -0.38783737, -0.38783737, -0.38783737,  2.57840031,
       -0.38783737,  2.57840031, -0.38783737, -0.38783737, -0.38783737,
       -0.38783737, -0.38783737, -0.38783737, -0.38783737, -0.38783737,
       -0.38783737, -0.38783737, -0.38783737, -0.38783737, -0.38783737,
       -0.38783737, -0.38783737,  2.57840031, -0.38783737, -0.38783737,
       -0.38783737, -0.38783737, -0.38783737,  2.57840031, -0.38783737,
       -0.38783737, -0.38783737, -0.38783737, -0.38783737, -0.38783737,
       -0.38783737, -0.38783737, -0.38783737, -0.38783737,  2.57840031,
       -0.38783737, -0.38783737, -0.38783737, -0.38783737, -0.38783737,
       -0.38783737, -0.38783737, -0.38783737,  2.57840031, -0.38783737,
       -0.38783737, -0.38783737, -0.38783737, -0.38783737, -0.38783737,
       -0.38783737, -0.38783737, -0.38783737,  2.57840031, -0.38783737,
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        2.57840031, -0.38783737, -0.38783737, -0.38783737, -0.38783737,
       -0.38783737, -0.38783737, -0.38783737, -0.38783737, -0.38783737,
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        2.57840031, -0.38783737, -0.38783737, -0.38783737, -0.38783737,
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        2.57840031, -0.38783737, -0.38783737,  2.57840031, -0.38783737,
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-0.38783737, -0.38783737, -0.38783737,  2.57840031, -0.38783737,
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 2.57840031, -0.38783737, -0.38783737,  2.57840031, -0.38783737,
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-0.38783737, -0.38783737, -0.38783737, -0.38783737,  2.57840031,
-0.38783737, -0.38783737,  2.57840031, -0.38783737,  2.57840031,
-0.38783737, -0.38783737, -0.38783737])
```

In [162…

```
y_train
```

```
array([   0,    0,  174,    0,    0,   64,   56,    0,    0,   48,    0,
```

Out[162…

```
 0,   32,   15,    3,   11,    0,    0,  105,   26,    0,    7,
 2,    1,    1,    1,   16,    3,    5,    6,    0,   13,    8,
11,    0,    3,   13,    0,    0,    7,    0,    0,    0,    0,
 0,    0,    0,   42,    0,    0,    0,    0,    6,    0,    0,
 0,    0,   10,    2,    0,   88,    0,    3,    0,    0,    1,
 0,   31, 1090,    8,    0,    0,    4,   17,    0,    0,    2,
 0,   12,    0,    4,    0,    5,    2,    0,    0,    0,    0,
 0,   61,    0,    0,    0,    0,    5,    4,    0,    0,    2,
 6,    0,    0,    0,    0,    2,    9,    0,   40,    0,   58,
 0,    1,    0,    0,    0,    0,    0,    4,    1,    2,    0,
 0,    4,    0,    0,    0,    2,   34,   10,   10,    1,    0,
 0,    0,    8,    9,    0,   16,    0,    0,    0,   54,    3,
 0,    0,    7,    0,    0,    3,    0,  278,   36,    0,    2,
 1,    0,    0,   23,    0,   20,    0,    0,    4,    0,    1,
 0,   14,    0,    0,    0,    0,    0,    1,    0,    6,    0,
 0,    6,    6,   26,    0,    0,    1,    4,    2,    0,    0,
 0,    1,    5,    0,   10,    0,    7,    8,    0,   22,    1,
 0,    3,    2,    0,   30,    3,    2,    0,    0,    0,   10,
 2,   37,    0,    0,    0,    6,    0,   27,    6,    0,    0,
11,    6,    0,    0,    0,    0,    9,    0,    6,   19,    0,
 0,    0,   51,    0,    0,    0,    0,   24,    0,    0,    0,
 8,    0,    0,    1,    0,   37,    0,    5,    1,    0,    0,
 0,    7,    0,    0,    0,    1,    0,    6,    0,    4,    0,
 0,   31,    0,    0,    0,   26,    0,    7,    0,    0,    1,
17,    8,    3,    2,    2,   13,  154,    0,    1,    0,    0,
28,    1,    0,    1,    0,    0,    1,    0,    1,    0,    0,
 1,    0,    2,   16,    5,    0,   95,    0,    0,    8,    2,
 0,  185,    0,    3,    0,    0,    8,    3,    3,   24,    5,
 0,    0,   49,    0,    0,    3,   28,   11,    0,   49,    1,
 1,    0,    0,    0,   82,  200,    0,    0,    0,    5,    1,
 0,   11,    0,    0,   39,    1,    0,   15,    1,    0,   43,
 9,    0,   30,   71,    0,    0,    1,    8,   13,    1,   46,
 5,    0,    0,    0,    2,    2,    0,    0,    0,  103,    0,
 0,   15,    2,    0,    6,    0,    0,    0,    4,   11,    0,
 0,    0,    0,    1,    9,   14,    0,    0,   86,    0,    3,
10,    0,    0,    0,    7,    0,  746,  212,    0,   35,    6,
 0,    0,   11,    1,   12,    0])
```

In [163…

```
from sklearn.linear_model import LogisticRegression
model = LogisticRegression()
model.fit(X_train, y_train)
```

Out[163…

```
LogisticRegression()
```

In [164…
```
y_pred = model.predict(X_test)
```

In [165…
```
from sklearn.metrics import confusion_matrix
confusion_matrix(y_test,y_pred)

from sklearn.metrics import accuracy_score
accuracy=accuracy_score(y_test,y_pred)
accuracy
```

Out[165…
```
0.5480769230769231
```

In [166…
```
from sklearn.metrics import mean_squared_error as mse
from sklearn.metrics import mean_absolute_error as mae
from sklearn.metrics import r2_score
from sklearn.metrics import accuracy_score,recall_score,precision_score

print('MSE = ', mse(y_pred, y_test))
print('MAE = ', mae(y_pred, y_test))
print('R2 Score = ', r2_score(y_pred, y_test))
```

```
MSE =  634.8173076923077
MAE =  7.913461538461538
R2 Score =  -4.929393233626168
```

In [167…
```
print('Accuracy Score : ' + str(accuracy_score(y_test,y_pred)))
print("Precision Score : ",precision_score(y_test, y_pred,
                                           pos_label='positive',
                                           average='micro'))
print("Recall Score : ",recall_score(y_test, y_pred,
                                     pos_label='positive',
                                     average='micro'))
print('R2 Score : ' + str(r2_score(y_test,y_pred)))
from sklearn.metrics import confusion_matrix
print('Confusion Matrix : \n' + str(confusion_matrix(y_test,y_pred)))
```

```
Accuracy Score : 0.5480769230769231
Precision Score :  0.5480769230769231
Recall Score :  0.5480769230769231
R2 Score : -0.3183755038340548
Confusion Matrix :
[[57  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0]
 [ 3  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
```

```
[ 6  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 4  0  0  0  0  0  0  0  0  0  1  1  0  0  0  0  0  0  0  0  0]
[ 2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 2  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0]
[ 2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 4  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 1  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
[ 2  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]
[ 1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]]
```

In [168…
```
model.coef_.T
```

Out[168…
```
array([[-4.86996779e-02,  2.30546498e-01,  2.48314975e-01, ...,
         8.57551730e-01, -8.99913205e-02, -8.78096325e-02],
       [-7.96705856e-02, -3.27913316e-01,  1.11247404e-01, ...,
        -1.81259911e-01, -1.11339169e-01, -1.04789600e-01],
       [-2.01240025e-02,  2.14942503e-01,  3.66704242e-01, ...,
        -1.11704298e-01, -1.56222440e-01, -1.52961542e-01],
       ...,
       [-6.44109694e-04, -3.68425878e-01,  3.40506598e-01, ...,
         5.12493386e-01, -4.07314420e-01, -4.15219488e-01],
       [-1.87295166e-01, -2.60610997e-01, -2.32801788e-01, ...,
         1.47241920e-01,  2.38356650e-01,  2.83399741e-01],
       [ 1.74442725e-01, -5.03905221e-02,  3.29038051e-01, ...,
        -2.28931258e-03, -2.62254187e-03, -7.74670519e-04]])
```

In [169…
```
from wandb.keras import WandbCallback

wandb.login()
```

```
wandb: WARNING Calling wandb.login() after wandb.init() has no effect.
```

Out[169…
```
True
```

```
In [170…  wandb.init(project='ForestFires-Prediction-SVM')
```

Finishing last run (ID:37wgkckw) before initializing another...

Waiting for W&B process to finish, PID 4636
Program ended successfully.

Find user logs for this run at: `C:\Users\Bill\Documents\Class Work\Principles of Datascience\Automobile\wandb\run-20210531_191117-37wgkckw\logs\debug.log`
Find internal logs for this run at: `C:\Users\Bill\Documents\Class Work\Principles of Datascience\Automobile\wandb\run-20210531_191117-37wgkckw\logs\debug-internal.log`

Run summary:

_runtime	12047
_timestamp	1622489524
_step	2

Run history:

_runtime	
_timestamp	
_step	

Synced 6 W&B file(s), 3 media file(s), 3 artifact file(s) and 0 other file(s)

Synced **hopeful-fire-1**: https://wandb.ai/kotut/ForestFires-Prediction-SVM/runs/37wgkckw
...Successfully finished last run (ID:37wgkckw). Initializing new run:

```
wandb: wandb version 0.10.31 is available!  To upgrade, please run:
wandb:  $ pip install wandb --upgrade
```

Tracking run with wandb version 0.10.30

Syncing run **glowing-lion-2** to Weights & Biases (Documentation).

Project page: https://wandb.ai/kotut/ForestFires-Prediction-SVM

Run page: https://wandb.ai/kotut/ForestFires-Prediction-SVM/runs/3jikr432

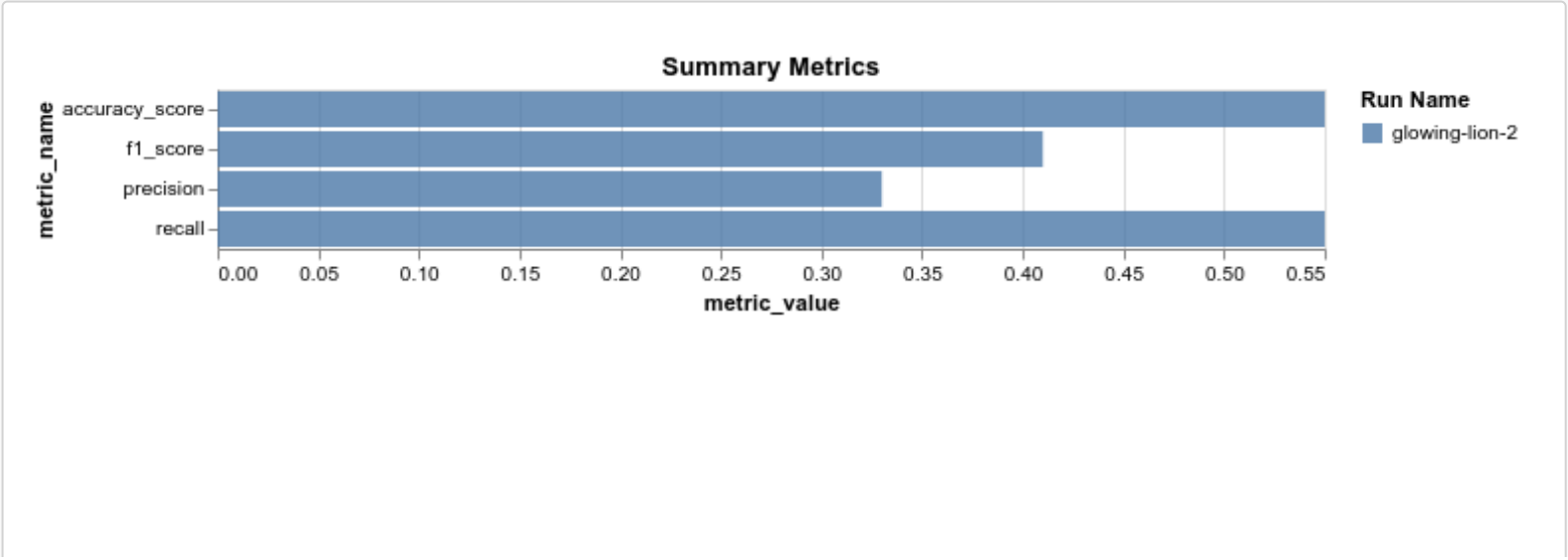
Run data is saved locally in `C:\Users\Bill\Documents\Class Work\Principles of Datascience\Automobile\wandb\run-20210531_234210-3jikr432`

Out[170…

Run(3jikr432)

Search panels

Media 2



In [171…

```
!pip install wandb --upgrade
```

```
Requirement already up-to-date: wandb in c:\users\bill\anaconda3\lib\site-packages (0.10.31)
Requirement already satisfied, skipping upgrade: sentry-sdk>=0.4.0 in c:\users\bill\anaconda3\lib\site-packages (from
wandb) (1.1.0)
Requirement already satisfied, skipping upgrade: shortuuid>=0.5.0 in c:\users\bill\anaconda3\lib\site-packages (from
wandb) (1.0.1)
Requirement already satisfied, skipping upgrade: psutil>=5.0.0 in c:\users\bill\anaconda3\lib\site-packages (from wan
db) (5.7.2)
Requirement already satisfied, skipping upgrade: six>=1.13.0 in c:\users\bill\anaconda3\lib\site-packages (from wand
b) (1.15.0)
Requirement already satisfied, skipping upgrade: promise<3,>=2.0 in c:\users\bill\anaconda3\lib\site-packages (from w
andb) (2.3)
Requirement already satisfied, skipping upgrade: requests<3,>=2.0.0 in c:\users\bill\anaconda3\lib\site-packages (fro
m wandb) (2.24.0)
Requirement already satisfied, skipping upgrade: python-dateutil>=2.6.1 in c:\users\bill\anaconda3\lib\site-packages
(from wandb) (2.8.1)
Requirement already satisfied, skipping upgrade: subprocess32>=3.5.3 in c:\users\bill\anaconda3\lib\site-packages (fr
om wandb) (3.5.4)
Requirement already satisfied, skipping upgrade: configparser>=3.8.1 in c:\users\bill\anaconda3\lib\site-packages (fr
om wandb) (5.0.2)
Requirement already satisfied, skipping upgrade: pathtools in c:\users\bill\anaconda3\lib\site-packages (from wandb)
(0.1.2)
Requirement already satisfied, skipping upgrade: docker-pycreds>=0.4.0 in c:\users\bill\anaconda3\lib\site-packages
(from wandb) (0.4.0)
Requirement already satisfied, skipping upgrade: protobuf>=3.12.0 in c:\users\bill\anaconda3\lib\site-packages (from
wandb) (3.17.0)
Requirement already satisfied, skipping upgrade: Click>=7.0 in c:\users\bill\anaconda3\lib\site-packages (from wandb)
(7.1.2)
Requirement already satisfied, skipping upgrade: PyYAML in c:\users\bill\anaconda3\lib\site-packages (from wandb) (5.
3.1)
Requirement already satisfied, skipping upgrade: GitPython>=1.0.0 in c:\users\bill\anaconda3\lib\site-packages (from
wandb) (3.1.17)
Requirement already satisfied, skipping upgrade: urllib3>=1.10.0 in c:\users\bill\anaconda3\lib\site-packages (from s
entry-sdk>=0.4.0->wandb) (1.25.11)
Requirement already satisfied, skipping upgrade: certifi in c:\users\bill\anaconda3\lib\site-packages (from sentry-sd
k>=0.4.0->wandb) (2020.6.20)
Requirement already satisfied, skipping upgrade: chardet<4,>=3.0.2 in c:\users\bill\anaconda3\lib\site-packages (from
requests<3,>=2.0.0->wandb) (3.0.4)
Requirement already satisfied, skipping upgrade: idna<3,>=2.5 in c:\users\bill\anaconda3\lib\site-packages (from requ
ests<3,>=2.0.0->wandb) (2.10)
Requirement already satisfied, skipping upgrade: gitdb<5,>=4.0.1 in c:\users\bill\anaconda3\lib\site-packages (from G
itPython>=1.0.0->wandb) (4.0.7)
Requirement already satisfied, skipping upgrade: smmap<5,>=3.0.1 in c:\users\bill\anaconda3\lib\site-packages (from g
itdb<5,>=4.0.1->GitPython>=1.0.0->wandb) (4.0.0)
```

In [173…
```
wandb.sklearn.plot_regressor(model, X_train, X_test, y_train, y_test, model_name='Ridge')
```

```
wandb:
wandb: Plotting Ridge.
wandb: Logged summary metrics.
wandb: Logged learning curve.
wandb: ERROR regressor is not a regressor. Please try again.
wandb: Logged outlier candidates.
wandb: ERROR regressor is not a regressor. Please try again.
wandb: Logged residuals.
```

In [175…
```
#Learning Curve
wandb.sklearn.plot_learning_curve(model, X, y)
```

In [ ]:
```
# Visualize all classifier plots
wandb.sklearn.plot_classifier(model, X_train, X_test, y_train, y_test, y_pred, y_probas, labels,
                                                        model_name='SVC', feature_names=None)

# All regression plots
wandb.sklearn.plot_regressor(model, X_train, X_test, y_train, y_test,  model_name='Ridge')

# All clustering plots
wandb.sklearn.plot_clusterer(model, X_train, cluster_labels, labels=None, model_name='KMeans')
```

In [ ]:
```
#Residuals
wandb.sklearn.plot_residuals(model, X, y)
```

In [187…
```
!pip install jupyter-cjk-xelatex
```

```
Collecting jupyter-cjk-xelatex
  Downloading jupyter-cjk-xelatex-0.2.tar.gz (1.6 kB)
Requirement already satisfied: jupyter in c:\users\bill\anaconda3\lib\site-packages (from jupyter-cjk-xelatex) (1.0.
0)
Requirement already satisfied: nbconvert in c:\users\bill\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xela
tex) (6.0.7)
Requirement already satisfied: ipykernel in c:\users\bill\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xela
tex) (5.3.4)
Requirement already satisfied: jupyter-console in c:\users\bill\anaconda3\lib\site-packages (from jupyter->jupyter-cj
k-xelatex) (6.2.0)
Requirement already satisfied: notebook in c:\users\bill\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xelat
ex) (6.1.4)
Requirement already satisfied: ipywidgets in c:\users\bill\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xel
```

```
atex) (7.5.1)
Requirement already satisfied: qtconsole in c:\users\bill\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xela
tex) (4.7.7)
Requirement already satisfied: testpath in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupyter->jupyte
r-cjk-xelatex) (0.4.4)
Requirement already satisfied: defusedxml in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupyter->jupy
ter-cjk-xelatex) (0.6.0)
Requirement already satisfied: pygments>=2.4.1 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupyter-
>jupyter-cjk-xelatex) (2.7.2)
Requirement already satisfied: mistune<2,>=0.8.1 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupyte
r->jupyter-cjk-xelatex) (0.8.4)
Requirement already satisfied: jupyterlab-pygments in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupy
ter->jupyter-cjk-xelatex) (0.1.2)
Requirement already satisfied: traitlets>=4.2 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupyter->
jupyter-cjk-xelatex) (5.0.5)
Requirement already satisfied: pandocfilters>=1.4.1 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jup
yter->jupyter-cjk-xelatex) (1.4.3)
Requirement already satisfied: nbformat>=4.4 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupyter->j
upyter-cjk-xelatex) (5.0.8)
Requirement already satisfied: jinja2>=2.4 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupyter->jup
yter-cjk-xelatex) (2.11.2)
Requirement already satisfied: nbclient<0.6.0,>=0.5.0 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->j
upyter->jupyter-cjk-xelatex) (0.5.1)
Requirement already satisfied: entrypoints>=0.2.2 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupyt
er->jupyter-cjk-xelatex) (0.3)
Requirement already satisfied: jupyter-core in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupyter->ju
pyter-cjk-xelatex) (4.6.3)
Requirement already satisfied: bleach in c:\users\bill\anaconda3\lib\site-packages (from nbconvert->jupyter->jupyter-
cjk-xelatex) (3.2.1)
Requirement already satisfied: jupyter-client in c:\users\bill\anaconda3\lib\site-packages (from ipykernel->jupyter->
jupyter-cjk-xelatex) (6.1.7)
Requirement already satisfied: tornado>=4.2 in c:\users\bill\anaconda3\lib\site-packages (from ipykernel->jupyter->ju
pyter-cjk-xelatex) (6.0.4)
Requirement already satisfied: ipython>=5.0.0 in c:\users\bill\anaconda3\lib\site-packages (from ipykernel->jupyter->
jupyter-cjk-xelatex) (7.19.0)
Requirement already satisfied: prompt-toolkit!=3.0.0,!=3.0.1,<3.1.0,>=2.0.0 in c:\users\bill\anaconda3\lib\site-packa
ges (from jupyter-console->jupyter->jupyter-cjk-xelatex) (3.0.8)
Requirement already satisfied: ipython-genutils in c:\users\bill\anaconda3\lib\site-packages (from notebook->jupyter-
>jupyter-cjk-xelatex) (0.2.0)
Requirement already satisfied: argon2-cffi in c:\users\bill\anaconda3\lib\site-packages (from notebook->jupyter->jupy
ter-cjk-xelatex) (20.1.0)
Requirement already satisfied: prometheus-client in c:\users\bill\anaconda3\lib\site-packages (from notebook->jupyter
->jupyter-cjk-xelatex) (0.8.0)
Requirement already satisfied: terminado>=0.8.3 in c:\users\bill\anaconda3\lib\site-packages (from notebook->jupyter-
>jupyter-cjk-xelatex) (0.9.1)
```

```
Requirement already satisfied: pyzmq>=17 in c:\users\bill\anaconda3\lib\site-packages (from notebook->jupyter->jupyte
r-cjk-xelatex) (19.0.2)
Requirement already satisfied: Send2Trash in c:\users\bill\anaconda3\lib\site-packages (from notebook->jupyter->jupyt
er-cjk-xelatex) (1.5.0)
Requirement already satisfied: widgetsnbextension~=3.5.0 in c:\users\bill\anaconda3\lib\site-packages (from ipywidget
s->jupyter->jupyter-cjk-xelatex) (3.5.1)
Requirement already satisfied: qtpy in c:\users\bill\anaconda3\lib\site-packages (from qtconsole->jupyter->jupyter-cj
k-xelatex) (1.9.0)
Requirement already satisfied: jsonschema!=2.5.0,>=2.4 in c:\users\bill\anaconda3\lib\site-packages (from nbformat>=
4.4->nbconvert->jupyter->jupyter-cjk-xelatex) (3.2.0)
Requirement already satisfied: MarkupSafe>=0.23 in c:\users\bill\anaconda3\lib\site-packages (from jinja2>=2.4->nbcon
vert->jupyter->jupyter-cjk-xelatex) (1.1.1)
Requirement already satisfied: async-generator in c:\users\bill\anaconda3\lib\site-packages (from nbclient<0.6.0,>=0.
5.0->nbconvert->jupyter->jupyter-cjk-xelatex) (1.10)
Requirement already satisfied: nest-asyncio in c:\users\bill\anaconda3\lib\site-packages (from nbclient<0.6.0,>=0.5.0
->nbconvert->jupyter->jupyter-cjk-xelatex) (1.4.2)
Requirement already satisfied: pywin32>=1.0; sys_platform == "win32" in c:\users\bill\anaconda3\lib\site-packages (fr
om jupyter-core->nbconvert->jupyter->jupyter-cjk-xelatex) (227)
Requirement already satisfied: webencodings in c:\users\bill\anaconda3\lib\site-packages (from bleach->nbconvert->jup
yter->jupyter-cjk-xelatex) (0.5.1)
Requirement already satisfied: packaging in c:\users\bill\anaconda3\lib\site-packages (from bleach->nbconvert->jupyte
r->jupyter-cjk-xelatex) (20.4)
Requirement already satisfied: six>=1.9.0 in c:\users\bill\anaconda3\lib\site-packages (from bleach->nbconvert->jupyt
er->jupyter-cjk-xelatex) (1.15.0)
Requirement already satisfied: python-dateutil>=2.1 in c:\users\bill\anaconda3\lib\site-packages (from jupyter-client
->ipykernel->jupyter->jupyter-cjk-xelatex) (2.8.1)
Requirement already satisfied: setuptools>=18.5 in c:\users\bill\anaconda3\lib\site-packages (from ipython>=5.0.0->ip
ykernel->jupyter->jupyter-cjk-xelatex) (50.3.1.post20201107)
Requirement already satisfied: jedi>=0.10 in c:\users\bill\anaconda3\lib\site-packages (from ipython>=5.0.0->ipykerne
l->jupyter->jupyter-cjk-xelatex) (0.17.1)
Requirement already satisfied: backcall in c:\users\bill\anaconda3\lib\site-packages (from ipython>=5.0.0->ipykernel-
>jupyter->jupyter-cjk-xelatex) (0.2.0)
Requirement already satisfied: decorator in c:\users\bill\anaconda3\lib\site-packages (from ipython>=5.0.0->ipykernel
->jupyter->jupyter-cjk-xelatex) (4.4.2)
Requirement already satisfied: colorama; sys_platform == "win32" in c:\users\bill\anaconda3\lib\site-packages (from i
python>=5.0.0->ipykernel->jupyter->jupyter-cjk-xelatex) (0.4.4)
Requirement already satisfied: pickleshare in c:\users\bill\anaconda3\lib\site-packages (from ipython>=5.0.0->ipykern
el->jupyter->jupyter-cjk-xelatex) (0.7.5)
Requirement already satisfied: wcwidth in c:\users\bill\anaconda3\lib\site-packages (from prompt-toolkit!=3.0.0,!=3.
0.1,<3.1.0,>=2.0.0->jupyter-console->jupyter->jupyter-cjk-xelatex) (0.2.5)
Requirement already satisfied: cffi>=1.0.0 in c:\users\bill\anaconda3\lib\site-packages (from argon2-cffi->notebook->
jupyter->jupyter-cjk-xelatex) (1.14.3)
Requirement already satisfied: pywinpty>=0.5 in c:\users\bill\anaconda3\lib\site-packages (from terminado>=0.8.3->not
ebook->jupyter->jupyter-cjk-xelatex) (0.5.7)
Requirement already satisfied: attrs>=17.4.0 in c:\users\bill\anaconda3\lib\site-packages (from jsonschema!=2.5.0,>=
```

```
2.4->nbformat>=4.4->nbconvert->jupyter->jupyter-cjk-xelatex) (20.3.0)
Requirement already satisfied: pyrsistent>=0.14.0 in c:\users\bill\anaconda3\lib\site-packages (from jsonschema!=2.5.
0,>=2.4->nbformat>=4.4->nbconvert->jupyter->jupyter-cjk-xelatex) (0.17.3)
Requirement already satisfied: pyparsing>=2.0.2 in c:\users\bill\anaconda3\lib\site-packages (from packaging->bleach-
>nbconvert->jupyter->jupyter-cjk-xelatex) (2.4.7)
Requirement already satisfied: parso<0.8.0,>=0.7.0 in c:\users\bill\anaconda3\lib\site-packages (from jedi>=0.10->ipy
thon>=5.0.0->ipykernel->jupyter->jupyter-cjk-xelatex) (0.7.0)
Requirement already satisfied: pycparser in c:\users\bill\anaconda3\lib\site-packages (from cffi>=1.0.0->argon2-cffi-
>notebook->jupyter->jupyter-cjk-xelatex) (2.20)
Building wheels for collected packages: jupyter-cjk-xelatex
  Building wheel for jupyter-cjk-xelatex (setup.py): started
  Building wheel for jupyter-cjk-xelatex (setup.py): finished with status 'done'
  Created wheel for jupyter-cjk-xelatex: filename=jupyter_cjk_xelatex-0.2-py3-none-any.whl size=2082 sha256=d61d5c4c5
8aa746d0ca184d4284876a21d97d5cbf06ec824dc124903ee309c94
  Stored in directory: c:\users\bill\appdata\local\pip\cache\wheels\86\f2\af\ed577b70f797ea8e66810a8e15ea49c2e84888e0
c4a0815ca3
Successfully built jupyter-cjk-xelatex
Installing collected packages: jupyter-cjk-xelatex
Successfully installed jupyter-cjk-xelatex-0.2
```

In [188…

```
!pip install nbconvert
```

```
Requirement already satisfied: nbconvert in c:\users\bill\anaconda3\lib\site-packages (6.0.7)
Requirement already satisfied: nbclient<0.6.0,>=0.5.0 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert)
(0.5.1)
Requirement already satisfied: pygments>=2.4.1 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (2.7.2)
Requirement already satisfied: jupyterlab-pygments in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (0.
1.2)
Requirement already satisfied: defusedxml in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (0.6.0)
Requirement already satisfied: jinja2>=2.4 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (2.11.2)
Requirement already satisfied: jupyter-core in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (4.6.3)
Requirement already satisfied: mistune<2,>=0.8.1 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (0.8.
4)
Requirement already satisfied: nbformat>=4.4 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (5.0.8)
Requirement already satisfied: testpath in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (0.4.4)
Requirement already satisfied: pandocfilters>=1.4.1 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (1.
4.3)
Requirement already satisfied: entrypoints>=0.2.2 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (0.3)
Requirement already satisfied: traitlets>=4.2 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (5.0.5)
Requirement already satisfied: bleach in c:\users\bill\anaconda3\lib\site-packages (from nbconvert) (3.2.1)
Requirement already satisfied: jupyter-client>=6.1.5 in c:\users\bill\anaconda3\lib\site-packages (from nbclient<0.6.
0,>=0.5.0->nbconvert) (6.1.7)
Requirement already satisfied: nest-asyncio in c:\users\bill\anaconda3\lib\site-packages (from nbclient<0.6.0,>=0.5.0
->nbconvert) (1.4.2)
Requirement already satisfied: async-generator in c:\users\bill\anaconda3\lib\site-packages (from nbclient<0.6.0,>=0.
```

```
5.0->nbconvert) (1.10)
Requirement already satisfied: MarkupSafe>=0.23 in c:\users\bill\anaconda3\lib\site-packages (from jinja2>=2.4->nbcon
vert) (1.1.1)
Requirement already satisfied: pywin32>=1.0; sys_platform == "win32" in c:\users\bill\anaconda3\lib\site-packages (fr
om jupyter-core->nbconvert) (227)
Requirement already satisfied: jsonschema!=2.5.0,>=2.4 in c:\users\bill\anaconda3\lib\site-packages (from nbformat>=
4.4->nbconvert) (3.2.0)
Requirement already satisfied: ipython-genutils in c:\users\bill\anaconda3\lib\site-packages (from nbformat>=4.4->nbc
onvert) (0.2.0)
Requirement already satisfied: webencodings in c:\users\bill\anaconda3\lib\site-packages (from bleach->nbconvert) (0.
5.1)
Requirement already satisfied: packaging in c:\users\bill\anaconda3\lib\site-packages (from bleach->nbconvert) (20.4)
Requirement already satisfied: six>=1.9.0 in c:\users\bill\anaconda3\lib\site-packages (from bleach->nbconvert) (1.1
5.0)
Requirement already satisfied: tornado>=4.1 in c:\users\bill\anaconda3\lib\site-packages (from jupyter-client>=6.1.5-
>nbclient<0.6.0,>=0.5.0->nbconvert) (6.0.4)
Requirement already satisfied: python-dateutil>=2.1 in c:\users\bill\anaconda3\lib\site-packages (from jupyter-client
>=6.1.5->nbclient<0.6.0,>=0.5.0->nbconvert) (2.8.1)
Requirement already satisfied: pyzmq>=13 in c:\users\bill\anaconda3\lib\site-packages (from jupyter-client>=6.1.5->nb
client<0.6.0,>=0.5.0->nbconvert) (19.0.2)
Requirement already satisfied: setuptools in c:\users\bill\anaconda3\lib\site-packages (from jsonschema!=2.5.0,>=2.4-
>nbformat>=4.4->nbconvert) (50.3.1.post20201107)
Requirement already satisfied: attrs>=17.4.0 in c:\users\bill\anaconda3\lib\site-packages (from jsonschema!=2.5.0,>=
2.4->nbformat>=4.4->nbconvert) (20.3.0)
Requirement already satisfied: pyrsistent>=0.14.0 in c:\users\bill\anaconda3\lib\site-packages (from jsonschema!=2.5.
0,>=2.4->nbformat>=4.4->nbconvert) (0.17.3)
Requirement already satisfied: pyparsing>=2.0.2 in c:\users\bill\anaconda3\lib\site-packages (from packaging->bleach-
>nbconvert) (2.4.7)
```

In [190…

```
!pip install nbconvert[webpdf]
```

```
Requirement already satisfied: nbconvert[webpdf] in c:\users\bill\anaconda3\lib\site-packages (6.0.7)
Requirement already satisfied: traitlets>=4.2 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpdf])
(5.0.5)
Requirement already satisfied: defusedxml in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpdf]) (0.6.
0)
Requirement already satisfied: pandocfilters>=1.4.1 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webp
df]) (1.4.3)
Requirement already satisfied: testpath in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpdf]) (0.4.4)
Requirement already satisfied: jupyter-core in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpdf]) (4.
6.3)
Requirement already satisfied: jinja2>=2.4 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpdf]) (2.1
1.2)
Requirement already satisfied: nbclient<0.6.0,>=0.5.0 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[we
bpdf]) (0.5.1)
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Requirement already satisfied: bleach in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpdf]) (3.2.1)
Requirement already satisfied: mistune<2,>=0.8.1 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpd
f]) (0.8.4)
Requirement already satisfied: pygments>=2.4.1 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpdf])
(2.7.2)
Requirement already satisfied: entrypoints>=0.2.2 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpd
f]) (0.3)
Requirement already satisfied: jupyterlab-pygments in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpd
f]) (0.1.2)
Requirement already satisfied: nbformat>=4.4 in c:\users\bill\anaconda3\lib\site-packages (from nbconvert[webpdf])
(5.0.8)
Requirement already satisfied: pyppeteer==0.2.2; extra == "webpdf" in c:\users\bill\anaconda3\lib\site-packages (from
nbconvert[webpdf]) (0.2.2)
Requirement already satisfied: ipython-genutils in c:\users\bill\anaconda3\lib\site-packages (from traitlets>=4.2->nb
convert[webpdf]) (0.2.0)
Requirement already satisfied: pywin32>=1.0; sys_platform == "win32" in c:\users\bill\anaconda3\lib\site-packages (fr
om jupyter-core->nbconvert[webpdf]) (227)
Requirement already satisfied: MarkupSafe>=0.23 in c:\users\bill\anaconda3\lib\site-packages (from jinja2>=2.4->nbcon
vert[webpdf]) (1.1.1)
Requirement already satisfied: jupyter-client>=6.1.5 in c:\users\bill\anaconda3\lib\site-packages (from nbclient<0.6.
0,>=0.5.0->nbconvert[webpdf]) (6.1.7)
Requirement already satisfied: async-generator in c:\users\bill\anaconda3\lib\site-packages (from nbclient<0.6.0,>=0.
5.0->nbconvert[webpdf]) (1.10)
Requirement already satisfied: nest-asyncio in c:\users\bill\anaconda3\lib\site-packages (from nbclient<0.6.0,>=0.5.0
->nbconvert[webpdf]) (1.4.2)
Requirement already satisfied: webencodings in c:\users\bill\anaconda3\lib\site-packages (from bleach->nbconvert[webp
df]) (0.5.1)
Requirement already satisfied: six>=1.9.0 in c:\users\bill\anaconda3\lib\site-packages (from bleach->nbconvert[webpd
f]) (1.15.0)
Requirement already satisfied: packaging in c:\users\bill\anaconda3\lib\site-packages (from bleach->nbconvert[webpd
f]) (20.4)
Requirement already satisfied: jsonschema!=2.5.0,>=2.4 in c:\users\bill\anaconda3\lib\site-packages (from nbformat>=
4.4->nbconvert[webpdf]) (3.2.0)
Requirement already satisfied: appdirs<2.0.0,>=1.4.3 in c:\users\bill\anaconda3\lib\site-packages (from pyppeteer==0.
2.2; extra == "webpdf"->nbconvert[webpdf]) (1.4.4)
Requirement already satisfied: websockets<9.0,>=8.1 in c:\users\bill\anaconda3\lib\site-packages (from pyppeteer==0.
2.2; extra == "webpdf"->nbconvert[webpdf]) (8.1)
Requirement already satisfied: pyee<8.0.0,>=7.0.1 in c:\users\bill\anaconda3\lib\site-packages (from pyppeteer==0.2.
2; extra == "webpdf"->nbconvert[webpdf]) (7.0.4)
Requirement already satisfied: urllib3<2.0.0,>=1.25.8 in c:\users\bill\anaconda3\lib\site-packages (from pyppeteer==
0.2.2; extra == "webpdf"->nbconvert[webpdf]) (1.25.11)
Requirement already satisfied: tqdm<5.0.0,>=4.42.1 in c:\users\bill\anaconda3\lib\site-packages (from pyppeteer==0.2.
2; extra == "webpdf"->nbconvert[webpdf]) (4.50.2)
Requirement already satisfied: tornado>=4.1 in c:\users\bill\anaconda3\lib\site-packages (from jupyter-client>=6.1.5-
>nbclient<0.6.0,>=0.5.0->nbconvert[webpdf]) (6.0.4)
```

```
Requirement already satisfied: python-dateutil>=2.1 in c:\users\bill\anaconda3\lib\site-packages (from jupyter-client
>=6.1.5->nbclient<0.6.0,>=0.5.0->nbconvert[webpdf]) (2.8.1)
Requirement already satisfied: pyzmq>=13 in c:\users\bill\anaconda3\lib\site-packages (from jupyter-client>=6.1.5->nb
client<0.6.0,>=0.5.0->nbconvert[webpdf]) (19.0.2)
Requirement already satisfied: pyparsing>=2.0.2 in c:\users\bill\anaconda3\lib\site-packages (from packaging->bleach-
>nbconvert[webpdf]) (2.4.7)
Requirement already satisfied: setuptools in c:\users\bill\anaconda3\lib\site-packages (from jsonschema!=2.5.0,>=2.4-
>nbformat>=4.4->nbconvert[webpdf]) (50.3.1.post20201107)
Requirement already satisfied: pyrsistent>=0.14.0 in c:\users\bill\anaconda3\lib\site-packages (from jsonschema!=2.5.
0,>=2.4->nbformat>=4.4->nbconvert[webpdf]) (0.17.3)
Requirement already satisfied: attrs>=17.4.0 in c:\users\bill\anaconda3\lib\site-packages (from jsonschema!=2.5.0,>=
2.4->nbformat>=4.4->nbconvert[webpdf]) (20.3.0)
```

In [202…]
```
!jupyter nbconvert ForestFires.ipynb --to html
```

```
[NbConvertApp] Converting notebook ForestFires.ipynb to html
[NbConvertApp] Writing 849565 bytes to ForestFires.html
```

In [ ]:
```
```