Importing the libraries

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from collections import Counter
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.svm import SVC
from sklearn.metrics import precision_score
from sklearn.metrics import recall_score
from sklearn.metrics import f1_score
from xgboost import XGBClassifier

import matplotlib.pyplot as plt
import seaborn as sns
!pip install chart_studio
import chart_studio.plotly as py
import plotly.graph_objs as go
from plotly.offline import iplot, init_notebook_mode
import cufflinks
cufflinks.go_offline()
cufflinks.set_config_file(world_readable=True, theme='pearl')
#
```

```
    Requirement already satisfied: chart_studio in /usr/local/lib/python3.6/dist-packages
    Requirement already satisfied: six in /usr/local/lib/python3.6/dist-packages (from ch
    Requirement already satisfied: plotly in /usr/local/lib/python3.6/dist-packages (from
    Requirement already satisfied: requests in /usr/local/lib/python3.6/dist-packages (fr
    Requirement already satisfied: retrying>=1.3.3 in /usr/local/lib/python3.6/dist-packa
    Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.6/dist-packages
    Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/
    Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.6/dist-pac
    Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.6/dist-pa
```

Importing the datset

```
dataset = pd.read_csv("City_day.csv");

dataset.dropna(axis=0, subset = ["Air_quality", "Xylene", "AQI", "Toluene",
                                  "Benzene", "O3", "SO2", "CO", "NH3", "NOx",
                                  "NO2", "PM10", "PM2.5", "NO"], how = 'all', inplac
dataset.dropna(subset = ["Air_quality"], inplace=True)

x = dataset.iloc[:, :-1].values
```

```
x = dataset.iloc[:, :-1].values
y = dataset.iloc[:,15].values

print(dataset.head())
```

```
            City       Date   PM2.5  PM10  ...  Toluene  Xylene    AQI  Air_quality
28  Ahmedabad  1/29/2015   83.13   NaN  ...     0.00    3.14  209.0         Poor
29  Ahmedabad  1/30/2015   79.84   NaN  ...     0.00    4.81  328.0    Very Poor
30  Ahmedabad  1/31/2015   94.52   NaN  ...     0.01    7.67  514.0       Severe
31  Ahmedabad   2/1/2015  135.99   NaN  ...     0.04   25.87  782.0       Severe
32  Ahmedabad   2/2/2015  178.33   NaN  ...     0.06   35.61  914.0       Severe

[5 rows x 16 columns]
```

```
# Check for possible null values in the dataset as missing values potentially screw
dataset.isnull().sum()
```

```
City               0
Date               0
PM2.5            635
PM10            6975
NO               308
NO2              305
NOx             1785
NH3             6323
CO               416
SO2              554
O3               709
Benzene         3270
Toluene         5435
Xylene         14208
AQI                0
Air_quality        0
dtype: int64
```

Filling the missing values

```
imputer = SimpleImputer(missing_values = np.nan, strategy = 'median')
imputer = imputer.fit(x[:,2:15])
x[:,2:15] = imputer.transform(x[:,2:15])
```

Encoding the attributes

```
le_X_city = LabelEncoder()
le_X_date = LabelEncoder()
le_Y = LabelEncoder()
y = le_Y.fit_transform(y)

x[:,0] = le_X_city.fit_transform(x[:,0])
x[:,1] = le_X_date.fit_transform(x[:,1])
```

Data Analysis

```
dataset.info()
```

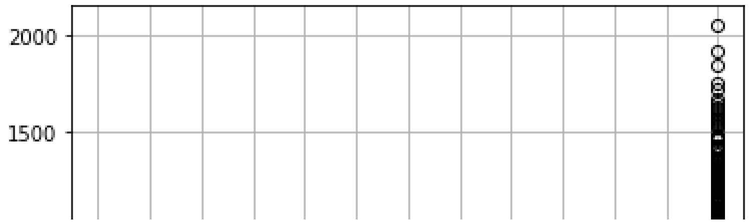
```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 21937 entries, 28 to 26218
Data columns (total 16 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   City         21937 non-null  object 
 1   Date         21937 non-null  object 
 2   PM2.5        21302 non-null  float64
 3   PM10         14962 non-null  float64
 4   NO           21629 non-null  float64
 5   NO2          21632 non-null  float64
 6   NOx          20152 non-null  float64
 7   NH3          15614 non-null  float64
 8   CO           21521 non-null  float64
 9   SO2          21383 non-null  float64
 10  O3           21228 non-null  float64
 11  Benzene      18667 non-null  float64
 12  Toluene      16502 non-null  float64
 13  Xylene       7729 non-null   float64
 14  AQI          21937 non-null  float64
 15  Air_quality  21937 non-null  object 
dtypes: float64(13), object(3)
memory usage: 2.8+ MB
```

```
# the describe method gives a quick overview of basic metrics of the dataset
dataset.describe()
```

	PM2.5	PM10	NO	NO2	NOx	
count	21302.000000	14962.000000	21629.000000	21632.000000	20152.000000	15614.000
mean	71.819536	125.867953	18.336627	29.537978	33.470678	25.751
std	65.402215	93.019867	22.987785	25.341563	31.934069	27.323
min	0.040000	0.030000	0.030000	0.010000	0.000000	0.010
25%	31.670000	61.692500	5.950000	12.100000	13.147500	9.630
50%	52.430000	101.555000	10.170000	22.360000	24.310000	18.420
75%	85.987500	158.837500	20.910000	38.702500	42.090000	33.130
max	914.940000	917.080000	287.140000	362.210000	293.100000	352.890

```
print(dataset.boxplot())
```

```
AxesSubplot(0.125,0.125;0.775x0.755)
```



Pre Corona [2016 to 2020]

Dividing the data set into two part namely Vehicular Pollution content (PM2.5, PM10, NO2, NH3, CO,) and Industrial Pollution content (CO, SO2, O3, Benzene, Toluene, Xylene) and find how these contents correlated with AQI (air quality index)

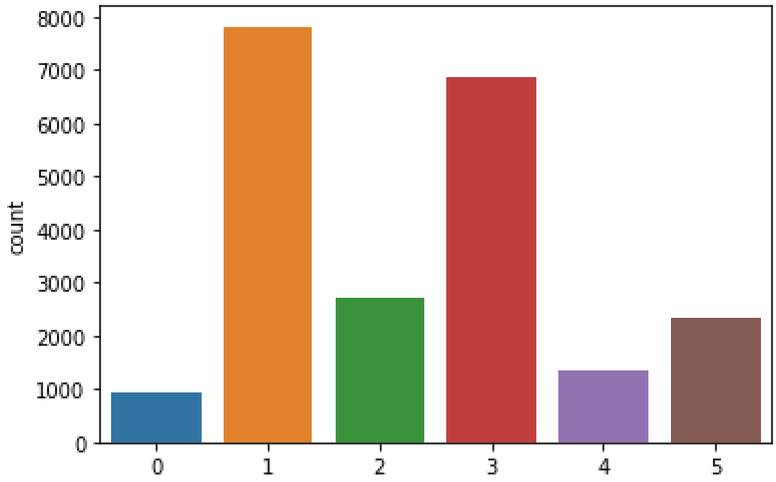
Splitting the dataset

```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.3, random_st
```

```
ax = sns.countplot(y)
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/_decorators.py:43: FutureWarning:

Pass the following variable as a keyword arg: x. From version 0.12, the only valid pc
```



```
#Before OverSampling
ax = sns.countplot(y_train)
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/_decorators.py:43: FutureWarning:

Pass the following variable as a keyword arg: x. From version 0.12, the only valid pc
```

OverSampling

```
print('Classes and number of values in trainset',Counter(y_train))
from imblearn.over_sampling import SMOTE
oversample = SMOTE()
x_train, y_train = oversample.fit_resample(x_train,y_train)
print('Classes and number of values in trainset after SMOTE:',Counter(y_train))
med=np.median(x_train,axis=0)
```

```
/usr/local/lib/python3.6/dist-packages/sklearn/externals/six.py:31: FutureWarning:

The module is deprecated in version 0.21 and will be removed in version 0.23 since we

/usr/local/lib/python3.6/dist-packages/sklearn/utils/deprecation.py:144: FutureWarnir

The sklearn.neighbors.base module is  deprecated in version 0.22 and will be removed

Classes and number of values in trainset Counter({1: 5450, 3: 4808, 2: 1867, 5: 1618,
/usr/local/lib/python3.6/dist-packages/sklearn/utils/deprecation.py:87: FutureWarning

Function safe_indexing is deprecated; safe_indexing is deprecated in version 0.22 anc

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Function safe_indexing is deprecated; safe_indexing is deprecated in version 0.22 anc

Classes and number of values in trainset after SMOTE: Counter({3: 5450, 1: 5450, 2: 5
/usr/local/lib/python3.6/dist-packages/sklearn/utils/deprecation.py:87: FutureWarning

Function safe_indexing is deprecated; safe_indexing is deprecated in version 0.22 anc
```
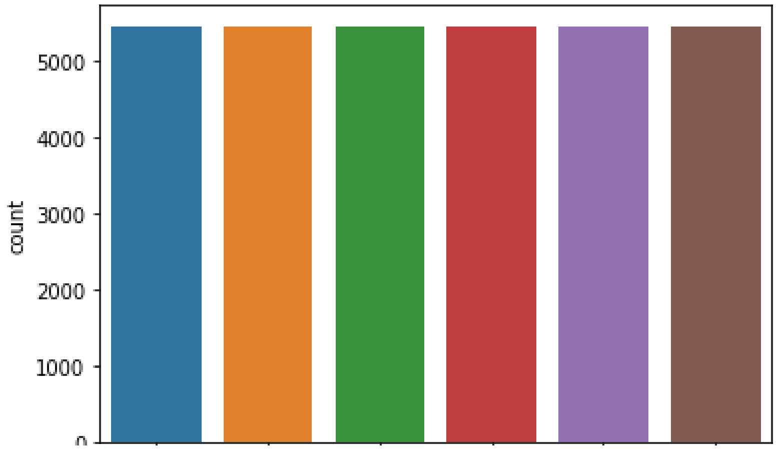

```
#After Oversampling
sns.countplot(y_train)
```

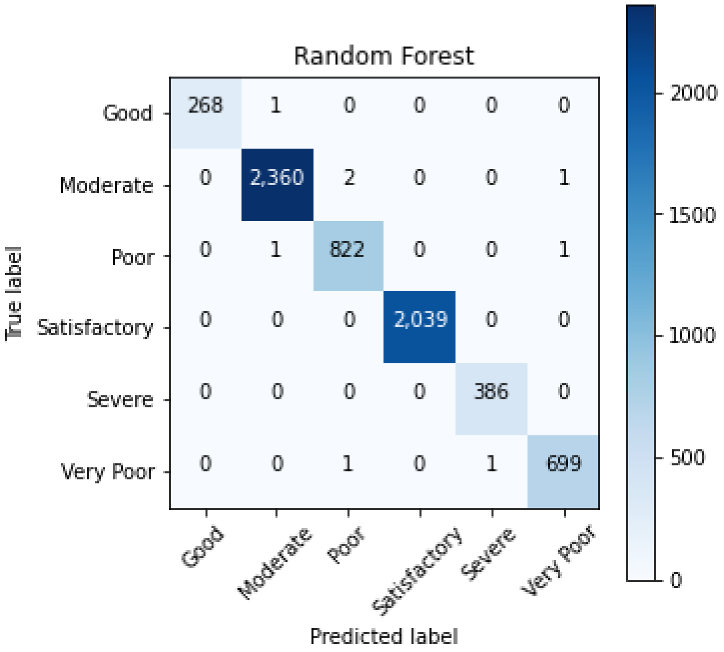
```
/usr/local/lib/python3.6/dist-packages/seaborn/_decorators.py:43: FutureWarning:

Pass the following variable as a keyword arg: x. From version 0.12, the only valid pc

<matplotlib.axes._subplots.AxesSubplot at 0x7fc4ad03f400>
```



```
classlabels=['Good','Moderate','Poor','Satisfactory','Severe','Very Poor']
import itertools
def plot_confusion_matrix(cm,title, classes=classlabels,
                          cmap=plt.cm.Blues):

    plt.figure(figsize=(5,4.8))
    plt.imshow(cm, interpolation='nearest', cmap=cmap)
    plt.title(title)
    plt.colorbar()
    tick_marks = np.arange(len(classes))
    plt.xticks(tick_marks, classes, rotation=45)
    plt.yticks(tick_marks, classes)

#     print(cm)

    thresh = cm.max() / 2
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
        plt.text(j, i, "{:,}".format(cm[i, j]),
                 horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.tight_layout()
    plt.ylabel('True label')
    plt.xlabel('Predicted label')


from sklearn.ensemble import RandomForestClassifier
clf=RandomForestClassifier(n_estimators=100,random_state = 0)
clf.fit(x_train,y_train)
y_pred=clf.predict(x_test)

from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
plot_confusion_matrix(cm,title="Random Forest")

a = accuracy_score(y_test,y_pred)
```

```
precision = precision_score(y_test,y_pred, average='micro')
recall = recall_score(y_test,y_pred, average='micro')
f1 = f1_score(y_test,y_pred, average='micro')
print("The accuracy of this model is : ", a*100)
print("Precision : ",precision*100)
print("Recall : ",recall*100)
print("F1 Score : ",f1*100)
```

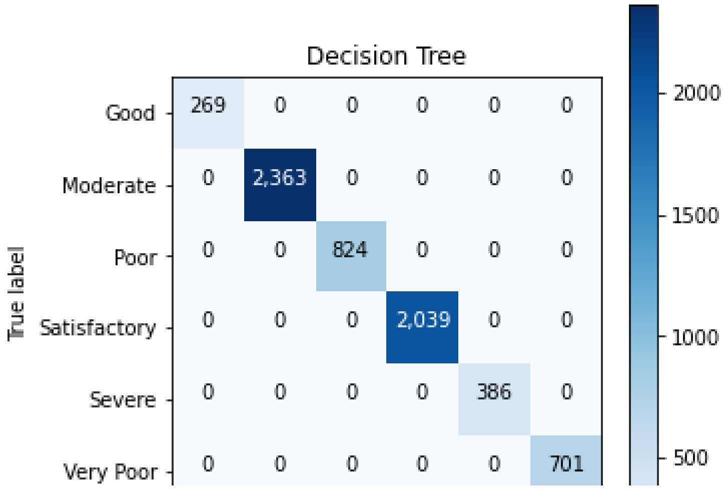
```
The accuracy of this model is :  99.87845639623215
Precision :  99.87845639623215
Recall :  99.87845639623215
F1 Score :  99.87845639623215
```



True label \ Predicted label	Good	Moderate	Poor	Satisfactory	Severe	Very Poor
Good	268	1	0	0	0	0
Moderate	0	2,360	2	0	0	1
Poor	0	1	822	0	0	1
Satisfactory	0	0	0	2,039	0	0
Severe	0	0	0	0	386	0
Very Poor	0	0	1	0	1	699

```
from sklearn.tree import DecisionTreeClassifier
dt = DecisionTreeClassifier(random_state = 0)
dt.fit(x_train,y_train)
y_pred = dt.predict(x_test)

from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
plot_confusion_matrix(cm,title="Decision Tree")

a = accuracy_score(y_test,y_pred)
precision = precision_score(y_test,y_pred, average='micro')
recall = recall_score(y_test,y_pred, average='micro')
f1 = f1_score(y_test,y_pred, average='micro')
print("The accuracy of this model is : ", a*100)
print("Precision : ",precision*100)
print("Recall : ",recall*100)
print("F1 Score : ",f1*100)
```

```
The accuracy of this model is :  100.0
Precision :  100.0
Recall :  100.0
F1 Score :  100.0
```



```
from xgboost import XGBClassifier
cls = XGBClassifier()
cls.fit(x_train,y_train)
y_pred = cls.predict(x_test)

from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
plot_confusion_matrix(cm,title="XGB")

a = accuracy_score(y_test,y_pred)
precision = precision_score(y_test,y_pred, average='micro')
recall = recall_score(y_test,y_pred, average='micro')
f1 = f1_score(y_test,y_pred, average='micro')
print("The accuracy of this model is : ", a*100)
print("Precision : ",precision*100)
print("Recall : ",recall*100)
print("F1 Score : ",f1*100)
```

```
The accuracy of this model is :  100.0
Precision :  100.0
Recall :  100.0
F1 Score :  100.0
```

```
res = []
city = le_X_city.fit_transform(["Pune"])
date = le_X_date.fit_transform(["12/12/2020"])
ls = [city[0] ,date[0], 83.13, 101.555, 6.93, 28.71, 33.72, 18.42, 6.93, 49.52, 59.7
lst = []
lst.append(ls)
temp = le_Y.inverse_transform(clf.predict(lst))
temp = temp.tolist()
res.append(temp[0])

temp = le_Y.inverse_transform(dt.predict(lst))
temp = temp.tolist()
res.append(temp[0])

temp = le_Y.inverse_transform(cls.predict(lst))
temp = temp.tolist()
res.append(temp[0])

print("Random Forest : ",res[0])
print("Decision Tree : ",res[1])
print("XGB : ",res[2])
```

```
Random Forest :  Poor
Decision Tree :  Poor
XGB :  Poor
```