Project Title: Water Quality Analysis

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Aim: The aim of this project is to predict the potability using classification machine learning model.

Explanation: This project has been divided into various steps.

a) The first basic step of any machine learning models is to import the basic libraries that are required. Which include pandas, numpy, matplotlib and seaborn.

Importing the Libraries

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

b) The second step is importing the dataset which will contain the values from which the machine will learn and take the decision.

Importing the dataset

```
dataset = pd.read_csv('water_potability.csv')
dataset.head()
```

	ph	Hardness	Solids	Chloramines	Sulfate	Conductivity	Organic_carbon	Trihalomethanes	Turbidity	Potability
0	NaN	204.890455	20791.318981	7.300212	368.516441	564.308654	10.379783	86.990970	2.963135	0
1	3.716080	129.422921	18630.057858	6.635246	NaN	592.885359	15.180013	56.329076	4.500656	0
2	8.099124	224.236259	19909.541732	9.275884	NaN	418.606213	16.868637	66.420093	3.055934	0
3	8.316766	214.373394	22018.417441	8.059332	356.886136	363.266516	18.436524	100.341674	4.628771	0
4	9.092223	181.101509	17978.986339	6.546600	310.135738	398.410813	11.558279	31.997993	4.075075	0

c) Exploratory Data Analysis: Finding if the dataset contains any null values

Exploratory Data Analysis

```
#Finding if there are any Nan values
dataset.isna().sum()
```

```
ph                 491
Hardness             0
Solids               0
Chloramines          0
Sulfate            781
Conductivity         0
Organic_carbon       0
Trihalomethanes    162
Turbidity            0
Potability           0
dtype: int64
```

Filling the missing values with the mean value of that respective columns so that there are not any errors while machine learns from the model.

```
#Filling the missing values
dataset['ph'] = dataset['ph'].fillna(dataset['ph'].mean())
dataset['Sulfate'] = dataset['Sulfate'].fillna(dataset['Sulfate'].mean())
dataset['Trihalomethanes'] = dataset['Trihalomethanes'].fillna(dataset['Trihalomethanes'].mean())
```

Getting the information and no of columns in the dataset.

```
#Finding the info about the dataset
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3276 entries, 0 to 3275
Data columns (total 10 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   ph               2785 non-null   float64
 1   Hardness         3276 non-null   float64
 2   Solids           3276 non-null   float64
 3   Chloramines      3276 non-null   float64
 4   Sulfate          2495 non-null   float64
 5   Conductivity     3276 non-null   float64
 6   Organic_carbon   3276 non-null   float64
 7   Trihalomethanes  3114 non-null   float64
 8   Turbidity        3276 non-null   float64
 9   Potability       3276 non-null   int64
dtypes: float64(9), int64(1)
memory usage: 256.1 KB
```

```
#Couting the total number of rows and columns
dataset.shape
```

```
(3276, 10)
```

Calculating the statistical values of each column in the dataset.

```
#Descriptive statics of the dataset
dataset.describe()
```

	ph	Hardness	Solids	Chloramines	Sulfate	Conductivity	Organic_carbon	Trihalomethanes	Turbidity	Potability
count	2785.000000	3276.000000	3276.000000	3276.000000	2495.000000	3276.000000	3276.000000	3114.000000	3276.000000	3276.000000
mean	7.080795	196.369496	22014.092526	7.122277	333.775777	426.205111	14.284970	66.396293	3.966786	0.390110
std	1.594320	32.879761	8768.570828	1.583085	41.416840	80.824064	3.308162	16.175008	0.780382	0.487849
min	0.000000	47.432000	320.942611	0.352000	129.000000	181.483754	2.200000	0.738000	1.450000	0.000000
25%	6.093092	176.850538	15666.690297	6.127421	307.699498	365.734414	12.065801	55.844536	3.439711	0.000000
50%	7.036752	196.967627	20927.833607	7.130299	333.073546	421.884968	14.218338	66.622485	3.955028	0.000000
75%	8.062066	216.667456	27332.762127	8.114887	359.950170	481.792304	16.557652	77.337473	4.500320	1.000000
max	14.000000	323.124000	61227.196008	13.127000	481.030642	753.342620	28.300000	124.000000	6.739000	1.000000

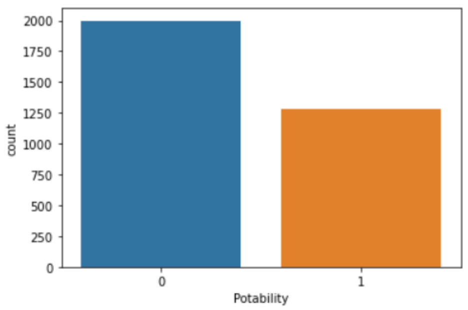
d) Visualizing the count of potability column using countplot of seaborn library.

Data Visualization

```
sns.countplot(dataset['Potability'])
```

```
D:\Anaconda\Anaconda_Software\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keyw
ord arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explic
it keyword will result in an error or misinterpretation.
  warnings.warn(
```

```
<AxesSubplot:xlabel='Potability', ylabel='count'>
```



e) Splitting the dataset into dependent and independent variable.

Splitting the dataset into dependent and independent variables

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

```
print(X)
```

```
[[7.08079450e+00 2.04890455e+02 2.07913190e+04 ... 1.03797831e+01
  8.69909705e+01 2.96313538e+00]
 [3.71608008e+00 1.29422921e+02 1.86300579e+04 ... 1.51800131e+01
  5.63290763e+01 4.50065627e+00]
 [8.09912419e+00 2.24236259e+02 1.99095417e+04 ... 1.68686369e+01
  6.64200925e+01 3.05593375e+00]
 ...
 [9.41951032e+00 1.75762646e+02 3.31555782e+04 ... 1.10390697e+01
  6.98454003e+01 3.29887550e+00]
 [5.12676292e+00 2.30603758e+02 1.19838694e+04 ... 1.11689462e+01
  7.74882131e+01 4.70865847e+00]
 [7.87467136e+00 1.95102299e+02 1.74041771e+04 ... 1.61403676e+01
  7.86984463e+01 2.30914906e+00]]
```

```
print(y)
```

```
[0 0 0 ... 1 1 1]
```

f) Now splitting the dataset into training and testing using model selector from sklearn library.

Splitting the dataset into training and testing

```
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 = 112)
```

```
print(X_train)
```

```
[[7.79845368e+00 1.88394942e+02 3.27045693e+04 ... 1.82724392e+01
  8.51776621e+01 4.10726720e+00]
 [9.57822672e+00 2.05748742e+02 3.30805888e+04 ... 1.69849614e+01
  6.89060880e+01 3.41923876e+00]
 [7.08079450e+00 2.86201763e+02 4.69318843e+04 ... 1.44716503e+01
  7.40438596e+01 4.12093142e+00]
 ...
 [6.17475058e+00 1.38513588e+02 2.15041388e+04 ... 1.42419652e+01
  3.17059331e+01 2.56604879e+00]
 [6.97866426e+00 1.83242796e+02 2.31144461e+04 ... 1.60828475e+01
  6.59957168e+01 4.76694324e+00]
 [3.73012801e+00 2.30299455e+02 1.68928957e+04 ... 1.03421456e+01
  4.70955058e+01 4.94303217e+00]]
```

```
print(X_test)
```

```
[[5.59672982e+00 2.29295098e+02 4.46523639e+04 ... 1.23618268e+01
  4.04120977e+01 3.82615819e+00]
 [7.08079450e+00 1.72111514e+02 2.65953735e+04 ... 7.87773851e+00
  9.33028160e+01 3.55031114e+00]
 [5.77219739e+00 2.00144971e+02 2.78406942e+04 ... 1.55501014e+01
  6.25212737e+01 3.07898584e+00]
 ...
 [5.59061444e+00 2.29192139e+02 3.53707355e+04 ... 1.32815561e+01
  7.69927158e+01 4.72684502e+00]
 [7.08079450e+00 2.15750221e+02 3.67761375e+04 ... 1.11803496e+01
  6.63962929e+01 4.75431312e+00]
 [7.08079450e+00 1.89814682e+02 1.98877698e+04 ... 1.29589170e+01
  7.09374813e+01 4.89375099e+00]]
```

```
print(y_train)
```

```
[1 0 1 ... 1 0 0]
```

```
print(y_test)
```

```
[0 0 0 0 1 0 1 0 1 0 0 0 1 0 0 0 0 0 0 1 1 0 1 0 0 0 1 0 0 0 0 0 1 1 1 0 1
 0 0 0 1 1 0 0 0 0 1 1 1 0 0 0 1 0 0 1 1 1 1 0 1 0 0 1 0 1 1 0 0 0 1 1 0 1
 0 0 0 0 1 1 0 0 0 0 0 0 0 1 1 0 1 0 1 1 0 1 0 1 0 1 1 1 1 1 0 0 0 1 1 0 1
 0 0 0 1 0 1 0 0 0 0 1 0 0 0 1 1 1 1 0 0 0 1 1 0 0 0 0 0 0 0 1 0 0 1 1 0 1
 0 0 1 0 1 1 1 0 1 0 0 0 0 0 1 0 0 0 1 0 1 1 0 1 1 1 0 0 0 1 0 0 0 0 1 0 0
 0 1 1 1 1 0 1 0 0 0 0 0 0 1 1 1 1 0 1 1 0 0 0 1 0 0 1 0 0 0 0 0 1 0 1 0 0
 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 1 1 0 0 0 0 1 0 1 1 1 0 0 1 0 0 1 0
 1 0 1 0 0 0 0 1 0 0 0 1 1 1 0 0 0 1 1 0 0 1 0 0 1 1 0 0 1 0 0 0 1 0 0 0 1
 0 0 0 0 1 1 0 1 0 0 1 1 0 0 0 1 0 1 0 1 0 0 0 0 0 1 0 0 0 1 1 0 0 0 0 1 0
 1 1 1 0 1 0 1 1 0 0 0 0 0 0 0 1 0 0 0 0 1 0 1 0 1 1 0 0 0 0 0 1 0 1 0 0 0
 0 0 0 0 0 0 0 0 1 1 1 0 1 0 0 0 0 0 0 1 0 0 1 0 1 0 0 1 0 0 1 0 1 0 1 1 0
 0 0 0 1 0 1 0 0 1 1 0 1 1 0 1 0 0 0 1 1 1 1 1 0 0 0 0 1 0 0 0 0 1 0 0 0 1
 0 0 0 0 1 1 0 0 1 0 0 0 1 1 0 0 1 0 0 0 0 1 0 1 1 0 0 1 0 0 1 0 1 1 0 0 0
 0 0 0 1 1 0 0 0 0 1 0 1 0 1 1 0 1 1 0 1 1 0 1 0 0 0 1 0 1 1 0 0 0 0 0 1 0
 0 0 0 1 0 1 1 1 0 0 0 0 1 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1 0 1 0 0 1
 1 0 1 1 0 1 0 0 0 0 1 0 0 1 1 0 1 1 0 1 0 0 0 0 0 1 0 1 0 0 0 0 1 1 1 1 0
 1 1 0 1 0 0 1 0 0 0 0 1 0 0 0 0 0 1 0 1 1 1 0 1 1 0 1 0 0 0 0 0 0 1 1 0 0
 0 0 1 1 0 0 0 0 1 1 0 1 0 0 1 0 1 0 0 1 0 0 1 1 0 0 0]
```

g) Applying feature scaling to the model to bring the values in the range on 0 to 1. So that there is no big difference in the values in various columns.

Applying Feature Scaling

```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

h) Training the Kernel Support vector Machine Learning model on the training dataset using rbf kernel and random state as 0.

Training the Kernel SVM model on the Training set

```
from sklearn.svm import SVC
classifier = SVC(kernel = 'rbf', random_state = 0)
classifier.fit(X_train, y_train)
```

```
SVC(random_state=0)
```

i) Now calculating the accuracy of the model and making the confusion matrix.

Making the Confusion Matrix

```
from sklearn.metrics import confusion_matrix, accuracy_score
y_pred = classifier.predict(X_test)
cm = confusion_matrix(y_test, y_pred)
print(cm)
accuracy_score(y_test, y_pred)
```

```
[[378  30]
 [183  65]]

0.6753048780487805
```

j) Now the model is ready to predict the new values.

Predicitng the result ¶

```
classifier.predict(sc.transform([[3.716080075,129.4229205,18630.05786,6.635245884,356.8861356,363.2665162,18.4365245,100.3416744
,4.628770537]]))
```

```
array([0], dtype=int64)
```

The support vector machine learning model have been developed to predict the potability of water with an 67% accuracy.