```
import time
st = time.time()
```

```
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import pandas as pd
import sklearn as skl
from sklearn.preprocessing import LabelEncoder
from sklearn.impute import SimpleImputer
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC,LinearSVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier, VotingClassifier, BaggingClassifier,
from sklearn.metrics import f1_score, confusion_matrix, ConfusionMatrixDisplay
from sklearn.preprocessing import StandardScaler ,RobustScaler
from sklearn.linear_model import LinearRegression
```

```
df = pd.read_csv('/content/drive/MyDrive/water_potability.csv')
df
```

	ph	Hardness	Solids	Chloramines	Sulfate	Conductivity	Orga
0	NaN	204.890455	20791.318981	7.300212	368.516441	564.308654	
1	3.716080	129.422921	18630.057858	6.635246	NaN	592.885359	
2	8.099124	224.236259	19909.541732	9.275884	NaN	418.606213	
3	8.316766	214.373394	22018.417441	8.059332	356.886136	363.266516	
4	9.092223	181.101509	17978.986339	6.546600	310.135738	398.410813	
...	...	...	...	...	...	...	
3271	4.668102	193.681735	47580.991603	7.166639	359.948574	526.424171	
3272	7.808856	193.553212	17329.802160	8.061362	NaN	392.449580	
3273	9.419510	175.762646	33155.578218	7.350233	NaN	432.044783	
3274	5.126763	230.603758	11983.869376	6.303357	NaN	402.883113	
3275	7.874671	195.102299	17404.177061	7.509306	NaN	327.459760	

3276 rows × 10 columns

```
df.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
```

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

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

```
imputer = SimpleImputer(strategy='mean')
cols_to_change = ['ph','Sulfate','Trihalomethanes']

for col in cols_to_change:
  df[col] = imputer.fit_transform(df[[col]])

df
```

```
                    ph   Hardness       Solids  Chloramines    Sulfate  Conductivity  Orga
```

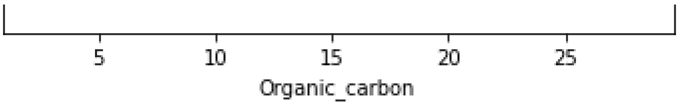
```
df.isnull().sum()
```

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

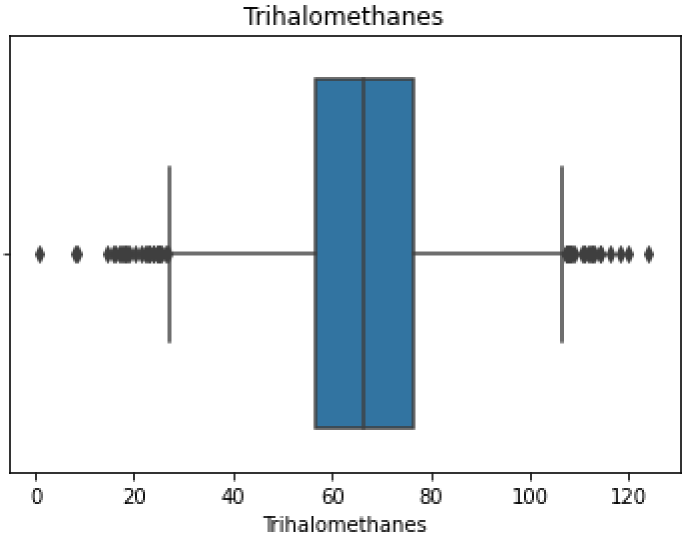
```
column_name = df.columns
column_name
```

```
Index(['ph', 'Hardness', 'Solids', 'Chloramines', 'Sulfate', 'Conductivity',
       'Organic_carbon', 'Trihalomethanes', 'Turbidity', 'Potability'],
      dtype='object')
```

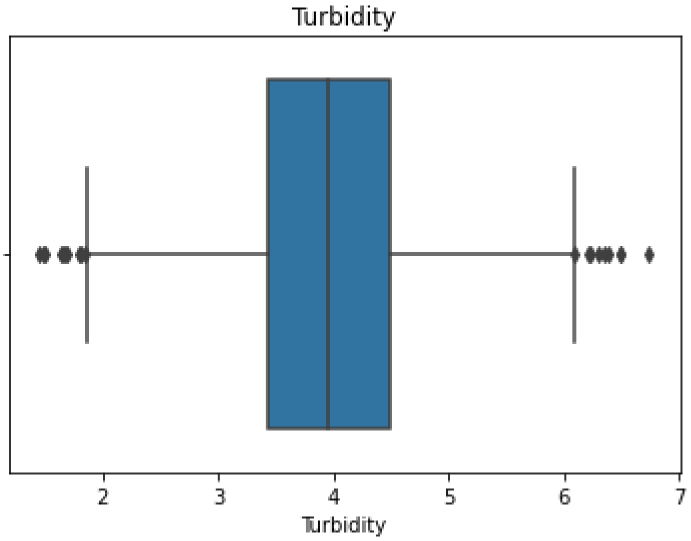
```
for boxcol in column_name:
  box = sns.boxplot(df[boxcol])
  plt.title(boxcol)
  plt.show(box)
```



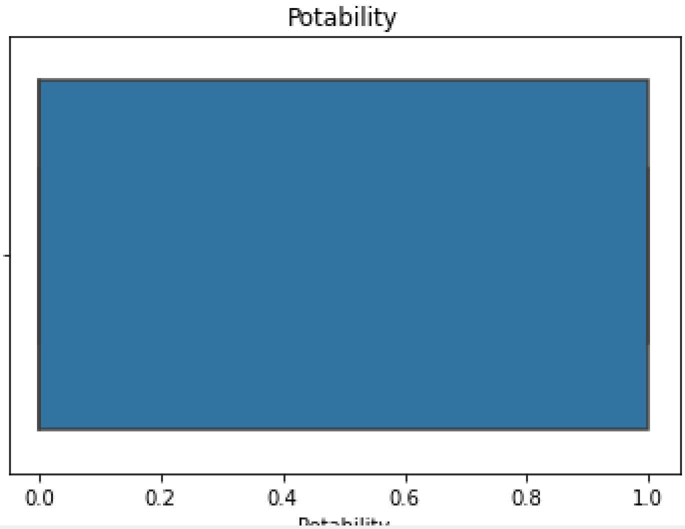
```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning:
  FutureWarning
```



```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning:
  FutureWarning
```



```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning:
  FutureWarning
```



```
turbidityoutl = (np.where(df['Turbidity']>6) or np.where(df['Turbidity']<2))
trihalomethanesoutl = (np.where(df['Trihalomethanes']<36) or np.where(df['Trihalomethanes'
organic_carbonoutl = (np.where(df['Organic_carbon']<6) or np.where(df['Organic_carbon']>23
conductivityoutl = (np.where(df['Conductivity']<200) or np.where(df['Conductivity']>666))
sulfateoutl = (np.where(df['Sulfate']<275) or np.where(df['Sulfate']>389))
chloraminesoutl = (np.where(df['Chloramines']<3.5) or np.where(df['Chloramines']>11.5))
solidsoutl = (np.where(df['Solids']>47689))
hardnessoutl = (np.where(df['Hardness']<135) or np.where(df['Hardness']>285))
pHoutl = (np.where(df['ph']<4) or np.where(df['ph']>10.5))
```

```
remove = pHoutl + hardnessoutl + solidsoutl + chloraminesoutl + sulfateoutl + conductivity
```

```
type(remove)
```

```
    tuple
```

```
type(turbidityoutl)
```

```
    tuple
```

```
a = []
for u in remove:
  u = np.ravel(u).tolist()
  a.append(u)
# a
```

```
type(a)
```

```
list
```

```
len(a)
```

```
9
```

```
count = 0
for i in range(0,8):
  count += len(a[i])

print(count)
```

```
574
```

```
new_k = []
for i in range(0,8):
  k = a[i]
  for elem in k:
      if elem not in new_k:
          new_k.append(elem)
```

```
type(new_k)
```

```
list
```

```
len(new_k)
```

```
510
```

```
df.shape
```

```
(3276, 10)
```

```
for g in new_k:
    df.drop(g, inplace=True)
```

```
df.shape
```

```
(2766, 10)
```

```
# for boxcol in column_name:
#   fig, ax = plt.subplots(figsize = (18,10))
#   plt.title(boxcol)
#   ax.scatter(df[boxcol], df['Potability'])
#   plt.show()

y = df['Potability']
y = pd.DataFrame(y)
y
```

```
      Potability
   0           0
   2           0
   3           0
   5           0
   6           0
  ...        ...
3271           1
3272           1
3273           1
3274           1
3275           1

2766 rows × 1 columns
```

```
x = df.drop(['Potability'], axis=1)
x
```

```
                    ph    Hardness        Solids  Chloramines     Sulfate  Conductivity  Orga
```

```
Sscaler = StandardScaler()
Rscaler = RobustScaler()
```

```
new_col_names = ['ph', 'Hardness', 'Solids', 'Chloramines', 'Sulfate', 'Conductivity',
       'Organic_carbon', 'Trihalomethanes', 'Turbidity']
```

```
def my_modelfit(my_model,my_x_train,my_y_train):
  my_model.fit(my_x_train, my_y_train.values.ravel())

def my_predict(my_model,my_x_test):
  y_pred = my_model.predict(my_x_test)
  return y_pred

def my_f1_score(my_y_test,my_y_pred):
  f1 = f1_score(my_y_test, my_y_pred, average='weighted') #average='weighted',average='mac
  return f1

def cr_scaler(my_scaler,my_x_train,my_x_test):
  my_tr = my_scaler.fit_transform(my_x_train)
  my_ts = my_scaler.fit_transform(my_x_test)
  # my_tr, my_ts = pd.DataFrame(my_tr, columns=[new_col_names]), pd.DataFrame(my_ts, colum
  return my_tr, my_ts

def my_conf_matrix(my_y_test,my_y_pred):
  cm = confusion_matrix(my_y_test, my_y_pred)
  cm_norm = np.round(cm/np.sum(cm,axis=1).reshape(-1,1),2)
  sns.heatmap(cm_norm,cmap='Greens',annot=True,
              cbar_kws={'orientation' : 'vertical','label' : 'Color bar'},
              fmt='.2f'
              )
  plt.xlabel('Predicted')
  plt.ylabel('Actual')
  plt.show()
  # cm_display = ConfusionMatrixDisplay(cm)
  # cm_display.plot()
  # plt.show()

def my_score(my_model,my_x_train,my_y_train):
  return my_model.score(my_x_train,my_y_train)
```

```
x_tr, x_ts, y_tr, y_ts = train_test_split(x, y, train_size=.8, shuffle=True)
```

```
x_tr.shape, x_ts.shape, y_tr.shape, y_ts.shape
```

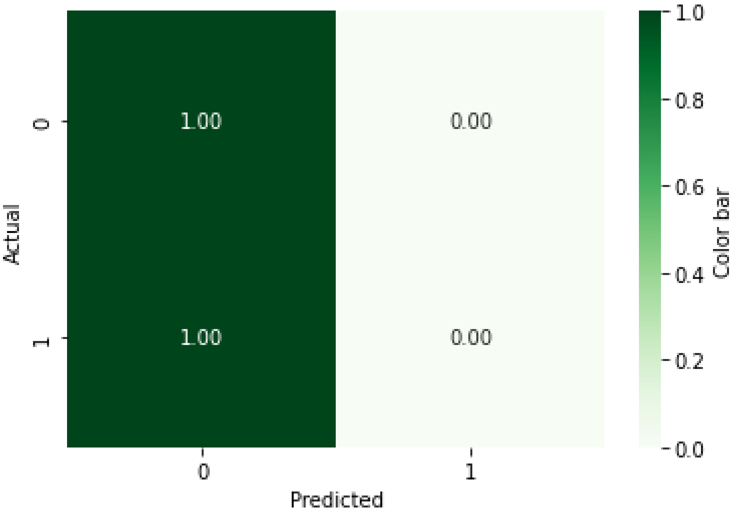
```
((2212, 9), (554, 9), (2212, 1), (554, 1))
```

```
clf1 = SVC(kernel= 'linear',C=25)
clf2 = KNeighborsClassifier(n_neighbors=25)
clf3 = DecisionTreeClassifier()
```

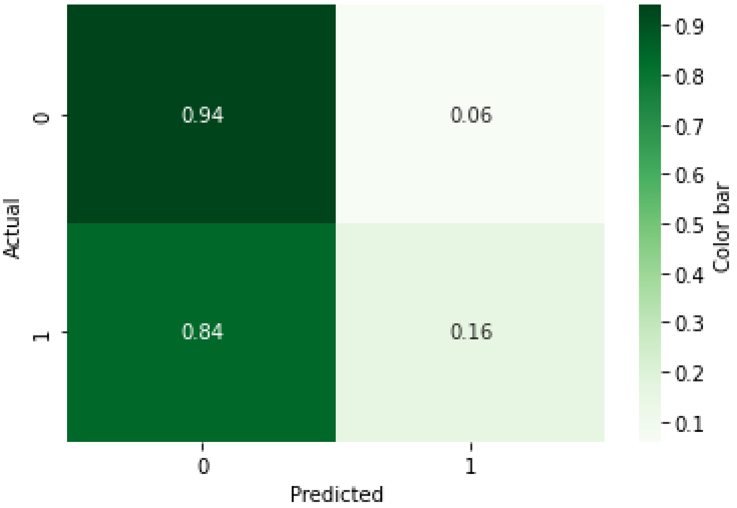
```
clf4 = RandomForestClassifier(n_estimators=100)
clf5 = SVC(kernel= 'rbf',C=25)
clf5 = LinearSVC()
clf7 = VotingClassifier(
                       voting='hard',
                       estimators=[('knr', clf2), ('rfr', clf3), ('svr2', clf4), ('lsvr',
                       )
clf8 = BaggingClassifier(clf3, n_estimators=100, max_samples=.8, n_jobs=-1) #For all cpu u
clf9 = GradientBoostingClassifier()


# x_tr[:10]


# x_tr, x_ts = cr_scaler(Sscaler, x_tr, x_ts)
# x_tr.shape, x_ts.shape, y_tr.shape, y_ts.shape


# x_tr[:10]


# x_tr, x_ts = cr_scaler(Rscaler, x_tr, x_ts)
# x_tr.shape, x_ts.shape, y_tr.shape, y_ts.shape


# x_tr[:10]


x_tr, x_ts = cr_scaler(Sscaler, x_tr, x_ts)

my_modelfit(clf1, x_tr, y_tr)
y_pred_res1 = my_predict(clf1,x_ts)
print(my_f1_score(y_ts,y_pred_res1))
print(my_score(clf1, x_tr, y_tr))
my_conf_matrix(y_ts,y_pred_res1)

my_modelfit(clf2, x_tr, y_tr)
y_pred_res2 = my_predict(clf2,x_ts)
print(my_f1_score(y_ts,y_pred_res2))
print(my_score(clf2, x_tr, y_tr))
my_conf_matrix(y_ts,y_pred_res2)

my_modelfit(clf3, x_tr, y_tr)
y_pred_res3 = my_predict(clf3,x_ts)
print(my_f1_score(y_ts,y_pred_res3))
print(my_score(clf3, x_tr, y_tr))
my_conf_matrix(y_ts,y_pred_res3)

my_modelfit(clf4, x_tr, y_tr)
y_pred_res4 = my_predict(clf4,x_ts)
print(my_f1_score(y_ts,y_pred_res4))
print(my_score(clf4, x_tr, y_tr))
my_conf_matrix(y_ts,y_pred_res4)

my_modelfit(clf5, x_tr, y_tr)
y_pred_res5 = my_predict(clf5,x_ts)
```

```
    print(my_f1_score(y_ts,y_pred_res5))
    print(my_score(clf5, x_tr, y_tr))
    my_conf_matrix(y_ts,y_pred_res5)

    my_modelfit(clf7, x_tr, y_tr)
    y_pred_res7 = my_predict(clf7,x_ts)
    print(my_f1_score(y_ts,y_pred_res7))
    print(my_score(clf7, x_tr, y_tr))
    my_conf_matrix(y_ts,y_pred_res7)

    my_modelfit(clf8, x_tr, y_tr)
    y_pred_res8 = my_predict(clf8,x_ts)
    print(my_f1_score(y_ts,y_pred_res8))
    print(my_score(clf8, x_tr, y_tr))
    my_conf_matrix(y_ts,y_pred_res8)

    my_modelfit(clf9, x_tr, y_tr)
    y_pred_res9 = my_predict(clf9,x_ts)
    print(my_f1_score(y_ts,y_pred_res9))
    print(my_score(clf9, x_tr, y_tr))
    my_conf_matrix(y_ts,y_pred_res9)
```

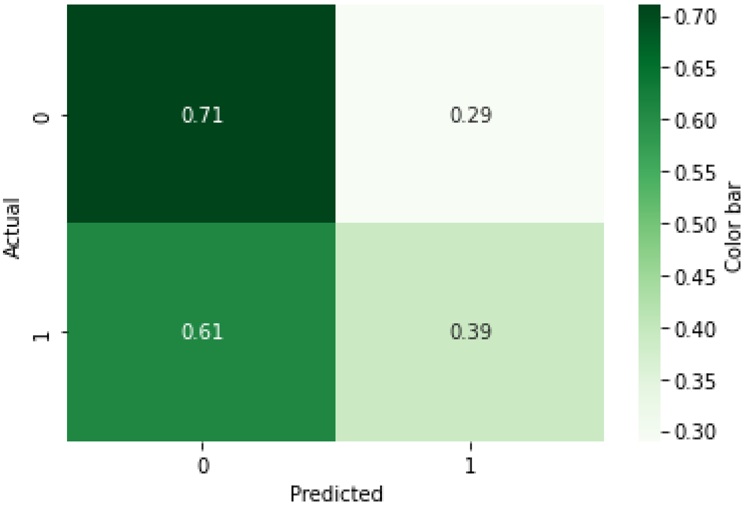
```
0.4513205181950272
0.6292947558770343
```



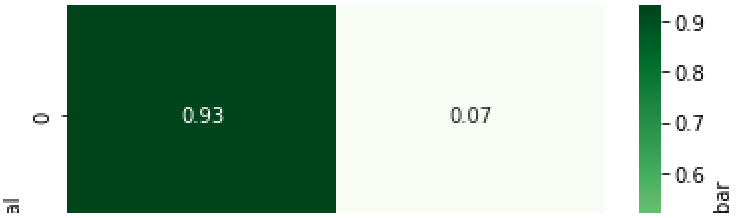
```
0.5552151936838594
0.6708860759493671
```



```
0.5712786445321755
1.0
```



```
0.6170237278937213
1.0
```


al
bar