```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
sns.set_theme(color_codes = True)
```

Dataset :

https://www.kaggle.com/datasets/abhia1999/chronic-kidney-disease

```
df = pd.read_csv('new_model.csv')
df
```

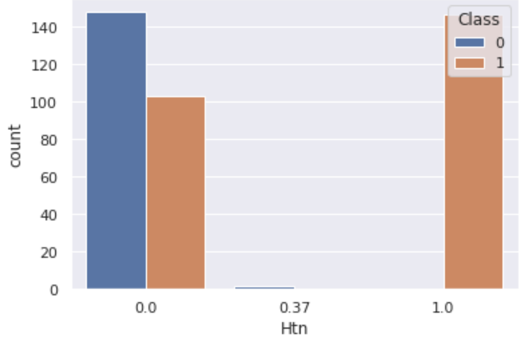
	Bp	Sg	Al	Su	Rbc	Bu	Sc	Sod	Pot	Hemo	Wbcc	Rbcc	Htn	Class
0	80.0	1.020	1.0	0.0	1.0	36.0	1.2	137.53	4.63	15.4	7800.0	5.20	1.0	1
1	50.0	1.020	4.0	0.0	1.0	18.0	0.8	137.53	4.63	11.3	6000.0	4.71	0.0	1
2	80.0	1.010	2.0	3.0	1.0	53.0	1.8	137.53	4.63	9.6	7500.0	4.71	0.0	1
3	70.0	1.005	4.0	0.0	1.0	56.0	3.8	111.00	2.50	11.2	6700.0	3.90	1.0	1
4	80.0	1.010	2.0	0.0	1.0	26.0	1.4	137.53	4.63	11.6	7300.0	4.60	0.0	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
395	80.0	1.020	0.0	0.0	1.0	49.0	0.5	150.00	4.90	15.7	6700.0	4.90	0.0	0
396	70.0	1.025	0.0	0.0	1.0	31.0	1.2	141.00	3.50	16.5	7800.0	6.20	0.0	0
397	80.0	1.020	0.0	0.0	1.0	26.0	0.6	137.00	4.40	15.8	6600.0	5.40	0.0	0
398	60.0	1.025	0.0	0.0	1.0	50.0	1.0	135.00	4.90	14.2	7200.0	5.90	0.0	0
399	80.0	1.025	0.0	0.0	1.0	18.0	1.1	141.00	3.50	15.8	6800.0	6.10	0.0	0

400 rows × 14 columns

Exploratory Data Analysis

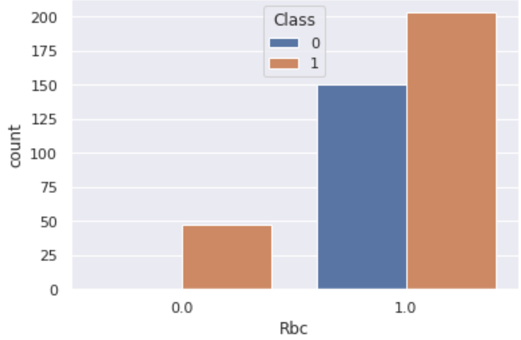
```
sns.countplot(data=df, x="Htn", hue="Class")
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5187149ca0>
```



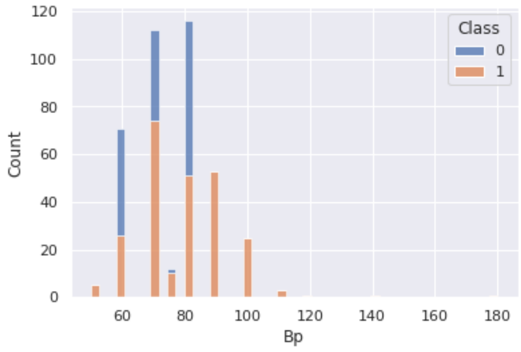
```
sns.countplot(data=df, x="Rbc", hue="Class")
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5187146ee0>
```



```
sns.histplot(data=df, x="Bp", hue="Class", multiple="stack")
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f518709ed90>
```



Data Preprocessing

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

```
Bp       0
Sg       0
Al       0
Su       0
Rbc      0
Bu       0
Sc       0
Sod      0
Pot      0
Hemo     0
Wbcc     0
Rbcc     0
Htn      0
Class    0
dtype: int64
```

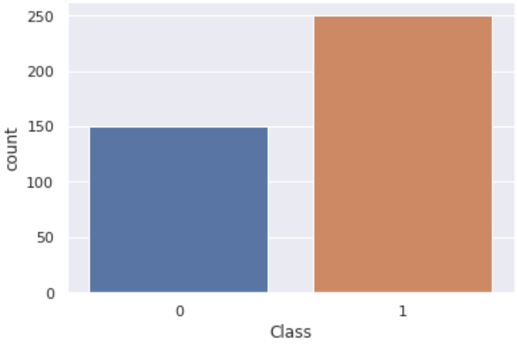
```
#replace 0 value with NaN
df_copy = df.copy(deep = True) #deep = True -> Buat salinan indeks dan data dalam dataframe
df_copy[['Bp','Sg','Bu','Sc','Sod','Pot','Hemo','Wbcc','Rbcc']] = df_copy[['Bp','Sg','Bu','Sc','Sod','Pot','Hemo','Wbcc','Rbcc']].replace(

# Showing the Count of NANs
print(df_copy.isnull().sum())
```

```
Bp       0
Sg       0
Al       0
Su       0
Rbc      0
Bu       0
Sc       0
Sod      0
Pot      0
Hemo     0
Wbcc     0
Rbcc     0
Htn      0
Class    0
dtype: int64
```

Check if the class label is balanced or not

```
sns.countplot(df['Class'])
print(df.Class.value_counts())
```

```
1    250
0    150
Name: Class, dtype: int64
/usr/local/lib/python3.8/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From
  warnings.warn(
```

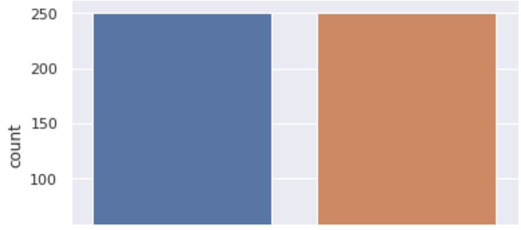


Do Oversampling Minority Class to Balance the class label

```
from sklearn.utils import resample
#create two different dataframe of majority and minority class
df_majority = df[(df['Class']==1)]
df_minority = df[(df['Class']==0)]
# upsample minority class
df_minority_upsampled = resample(df_minority,
                                 n_samples= 250,
                                 random_state=0)

# Combine majority class with upsampled minority class
df2 = pd.concat([df_minority_upsampled, df_majority])
```

```
sns.countplot(df2['Class'])
print(df2.Class.value_counts())
```

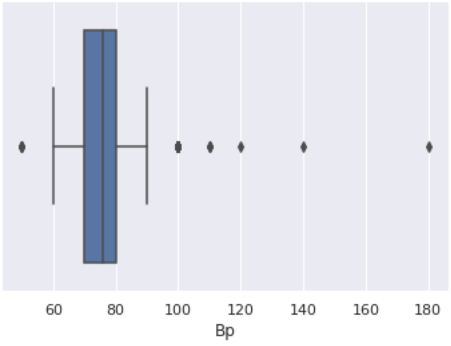
```
/usr/local/lib/python3.8/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From
  warnings.warn(
0    250
1    250
Name: Class, dtype: int64
```



Check the Outlier using Boxplot

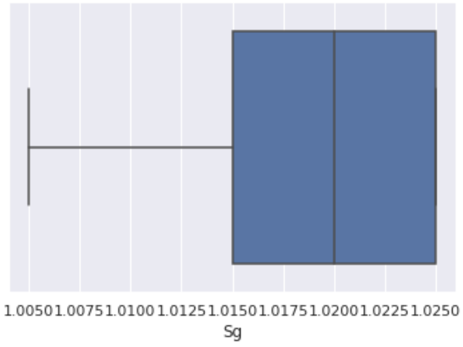
```
sns.boxplot(x=df2["Bp"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5186ed9970>
```



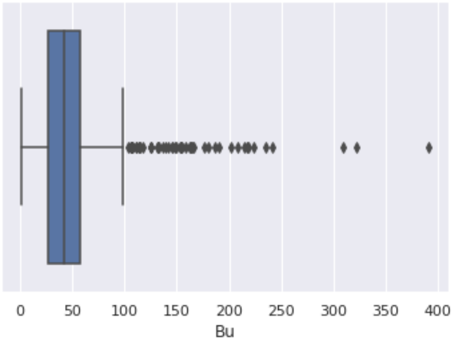
```
sns.boxplot(x=df2["Sg"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5186e83d90>
```



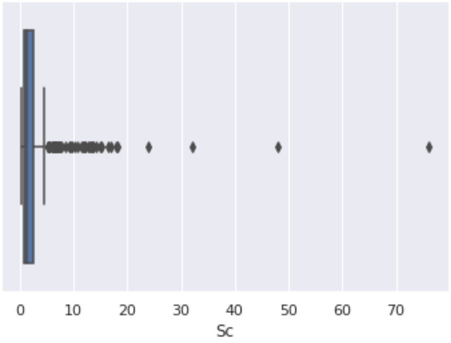
```
sns.boxplot(x=df2["Bu"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5186de2be0>
```



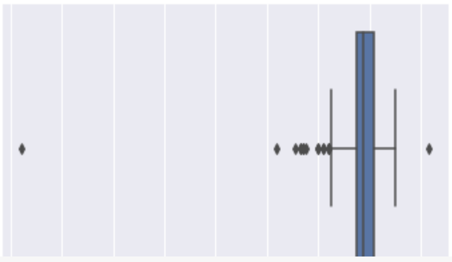
```
sns.boxplot(x=df2["Sc"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5186dc1dc0>
```



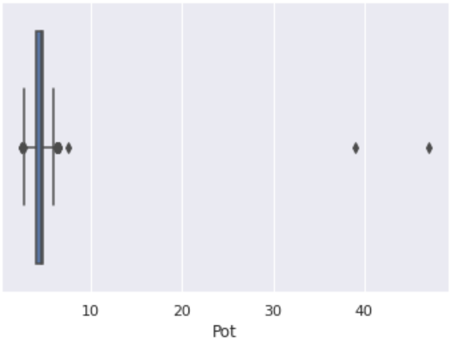
```
sns.boxplot(x=df2["Sod"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5186d0c790>
```



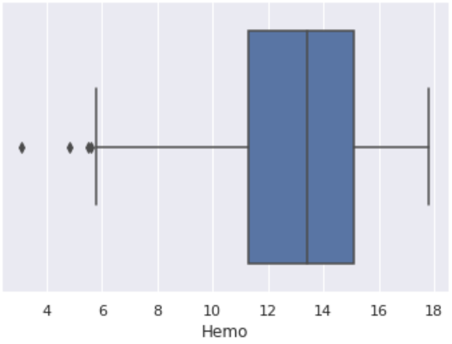
```
sns.boxplot(x=df2["Pot"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5186e8aa60>
```



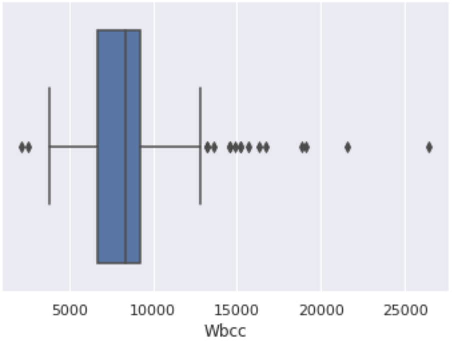
```
sns.boxplot(x=df2["Hemo"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5186cc4220>
```



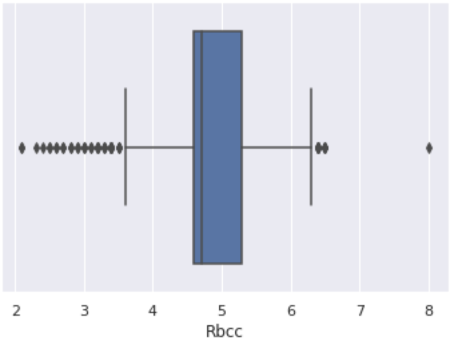
```
sns.boxplot(x=df2["Wbcc"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5186c775b0>
```



```
sns.boxplot(x=df2["Rbcc"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5186be32b0>
```



Remove Outlier using Z-Score

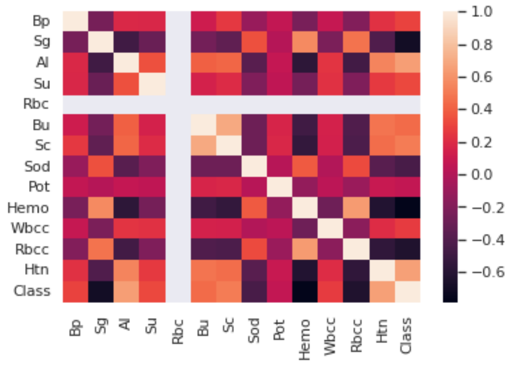
```
import scipy.stats as stats
z = np.abs(stats.zscore(df2))
data_clean = df2[(z<3).all(axis = 1)]
data_clean.shape
```

```
(420, 14)
```

Heatmap Data Correlation

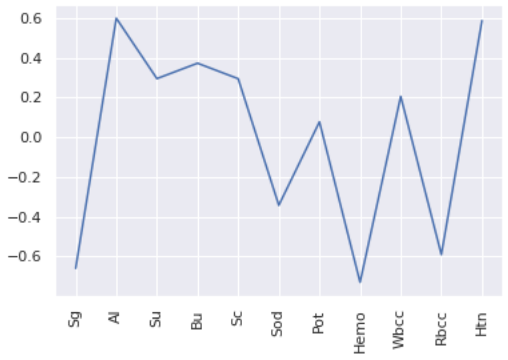
```
sns.heatmap(data_clean.corr(), fmt='.2g')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5186b513a0>
```



```
#Rbc attribute is irrlevant, so we have to remove it
data_clean2 = df.drop(columns=['Rbc'])
```

```
corr = data_clean2[data_clean2.columns[1:]].corr()['Class'][:-1]
plt.plot(corr)
plt.xticks(rotation=90)
plt.show()
```



Machine Learning Model Building

```
X = data_clean2.drop('Class', axis=1)
y = data_clean2['Class']
```

```
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.2,random_state=0)
```

Random Forest

```
from sklearn.ensemble import RandomForestClassifier
rfc = RandomForestClassifier(random_state=0)
rfc.fit(X_train, y_train)
```

```
RandomForestClassifier(random_state=0)
```

```
y_pred = rfc.predict(X_test)
print("Accuracy Score :", round(accuracy_score(y_test, y_pred)*100 ,2), "%")
```

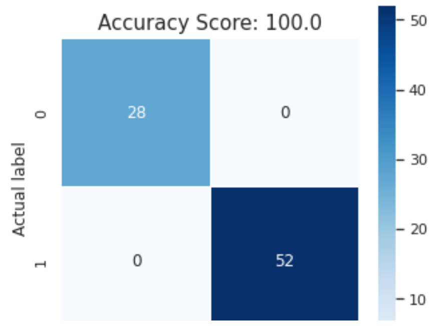
```
Accuracy Score : 100.0 %
```

```
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score
print('F-1 Score : ',(f1_score(y_test, y_pred)))
print('Precision Score : ',(precision_score(y_test, y_pred)))
print('Recall Score : ',(recall_score(y_test, y_pred)))
```

```
F-1 Score :  1.0
Precision Score :  1.0
Recall Score :  1.0
```

```
from sklearn.metrics import classification_report, confusion_matrix
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(5,5))
sns.heatmap(data=cm,linewidths=.5, annot=True,square = True,  cmap = 'Blues')
plt.ylabel('Actual label')
plt.xlabel('Predicted label')
all_sample_title = 'Accuracy Score: {0}'.format(rfc.score(X_test, y_test)*100)
plt.title(all_sample_title, size = 15)
```

```
Text(0.5, 1.0, 'Accuracy Score: 100.0')
```



KNearest Neighbor

```
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier()
knn.fit(X_train, y_train)
```

```
KNeighborsClassifier()
```

```
y_pred = knn.predict(X_test)
print("Accuracy Score :", round(accuracy_score(y_test, y_pred)*100 ,2), "%")
```

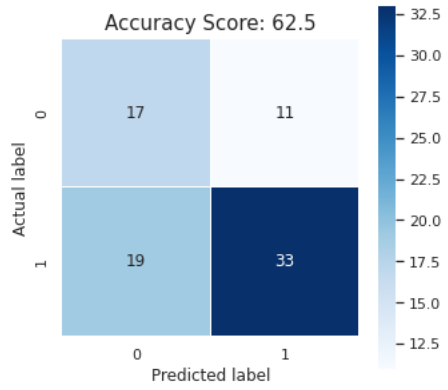
```
Accuracy Score : 62.5 %
```

```
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score
print('F-1 Score : ',(f1_score(y_test, y_pred)))
print('Precision Score : ',(precision_score(y_test, y_pred)))
print('Recall Score : ',(recall_score(y_test, y_pred)))
```

```
F-1 Score :  0.6875
Precision Score :  0.75
Recall Score :  0.6346153846153846
```

```
from sklearn.metrics import classification_report, confusion_matrix
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(5,5))
sns.heatmap(data=cm,linewidths=.5, annot=True,square = True,  cmap = 'Blues')
plt.ylabel('Actual label')
plt.xlabel('Predicted label')
all_sample_title = 'Accuracy Score: {0}'.format(knn.score(X_test, y_test)*100)
plt.title(all_sample_title, size = 15)
```

```
Text(0.5, 1.0, 'Accuracy Score: 62.5')
```



AdaBoost

```
from sklearn.ensemble import AdaBoostClassifier
ada = AdaBoostClassifier(random_state=0)
ada.fit(X_train, y_train)
```

```
AdaBoostClassifier(random_state=0)
```

```
y_pred = ada.predict(X_test)
print("Accuracy Score :", round(accuracy_score(y_test, y_pred)*100 ,2), "%")
```

```
Accuracy Score : 98.75 %
```

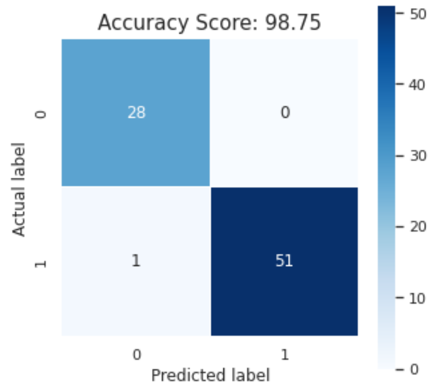
```
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score
print('F-1 Score : ',(f1_score(y_test, y_pred)))
print('Precision Score : ',(precision_score(y_test, y_pred)))
print('Recall Score : ',(recall_score(y_test, y_pred)))
```

```
F-1 Score :  0.9902912621359222
Precision Score :  1.0
Recall Score :  0.9807692307692307
```

```
from sklearn.metrics import classification_report, confusion_matrix
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(5,5))
sns.heatmap(data=cm,linewidths=.5, annot=True,square = True,  cmap = 'Blues')
plt.ylabel('Actual label')
plt.xlabel('Predicted label')
```

```
all_sample_title = 'Accuracy Score: {0}'.format(ada.score(X_test, y_test)*100)
plt.title(all_sample_title, size = 15)
```

```
Text(0.5, 1.0, 'Accuracy Score: 98.75')
```



Logistic Regression

```
from sklearn.linear_model import LogisticRegression
lr = LogisticRegression(random_state = 0)
lr.fit(X_train, y_train)
```

```
/usr/local/lib/python3.8/dist-packages/sklearn/linear_model/_logistic.py:814: ConvergenceWarning: lbfgs failed to converge (status=1):
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
  n_iter_i = _check_optimize_result(
LogisticRegression(random_state=0)
```

```
y_pred = lr.predict(X_test)
print("Accuracy Score :", round(accuracy_score(y_test, y_pred)*100 ,2), "%")
```

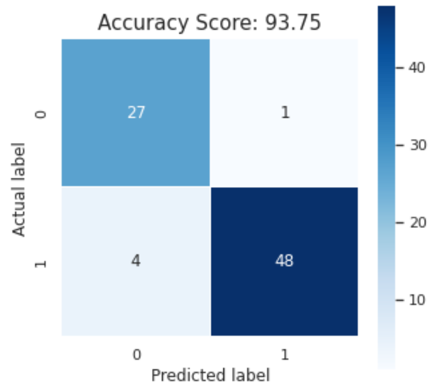
```
Accuracy Score : 93.75 %
```

```
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score
print('F-1 Score : ',(f1_score(y_test, y_pred)))
print('Precision Score : ',(precision_score(y_test, y_pred)))
print('Recall Score : ',(recall_score(y_test, y_pred)))
```

```
F-1 Score :  0.9504950495049506
Precision Score :  0.9795918367346939
Recall Score :  0.9230769230769231
```

```
from sklearn.metrics import classification_report, confusion_matrix
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(5,5))
sns.heatmap(data=cm,linewidths=.5, annot=True,square = True,  cmap = 'Blues')
plt.ylabel('Actual label')
plt.xlabel('Predicted label')
all_sample_title = 'Accuracy Score: {0}'.format(lr.score(X_test, y_test)*100)
plt.title(all_sample_title, size = 15)
```

```
Text(0.5, 1.0, 'Accuracy Score: 93.75')
```



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