Hyperparameter Tuning for kNN for Predicting Heart Disease

1. Import "heart.csv".

2. Import Library

```
import pandas as pd
import seaborn as sns
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import classification_report
from sklearn.model_selection import train_test_split
from sklearn.metrics import roc_auc_score
from sklearn.model_selection import GridSearchCV
```

3. Load the Dataset into a frame

```
df = pd.read_csv('/content/heart (1).csv')
```

4. Print the description, dimensions and first five records of the frame.

```
print(df.info())
print(df.shape)
print(df.head())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 303 entries, 0 to 302
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       303 non-null    int64  
 1   sex       303 non-null    int64  
 2   cp        303 non-null    int64  
 3   trestbps  303 non-null    int64  
 4   chol      303 non-null    int64  
 5   fbs       303 non-null    int64  
 6   restecg   303 non-null    int64  
 7   thalach   303 non-null    int64  
 8   exang     303 non-null    int64  
 9   oldpeak   303 non-null    float64
 10  slope     303 non-null    int64  
 11  ca        303 non-null    int64  
 12  thal      303 non-null    int64  
 13  target    303 non-null    int64  
dtypes: float64(1), int64(13)
memory usage: 33.3 KB
None
(303, 14)
   age  sex  cp  trestbps  chol  fbs  restecg  thalach  exang  oldpeak  slope  \
0   63    1   3       145   233    1        0      150      0      2.3      0   
1   37    1   2       130   250    0        1      187      0      3.5      0   
2   41    0   1       130   204    0        0      172      0      1.4      2   
3   56    1   1       120   236    0        1      178      0      0.8      2   
4   57    0   0       120   354    0        1      163      1      0.6      2   

   ca  thal  target  
0   0     1       1  
1   0     2       1  
2   0     2       1  
3   0     2       1  
4   0     2       1  
```

5. Check whether the data has any missing value in any column.

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

```
age         0
sex         0
cp          0
trestbps    0
chol        0
fbs         0
restecg     0
thalach     0
exang       0
oldpeak     0
slope       0
ca          0
thal        0
target      0
dtype: int64
```

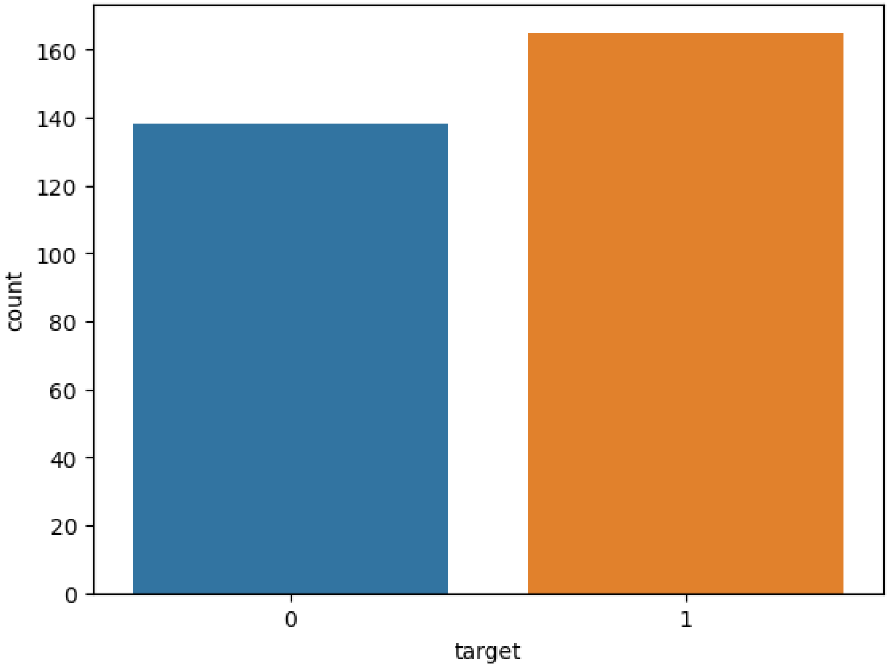
6. Check whether the data has balanced class distribution. Class target = 0 indicates "Heart Disease" and target = 1 indicates "No Heart Disease".

```
df['target'].value_counts()
```

```
1    165
0    138
Name: target, dtype: int64
```

```
sns.countplot(x='target',data=df)
```

```
<Axes: xlabel='target', ylabel='count'>
```



7. Create input features X, target Y, classifier object, train-test-split using 80-20% split

```
x = df.drop(columns=['target'])
y = df['target']

x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, random_state=4)
```

8. Train model

```
#Training the model
knn = KNeighborsClassifier()
knn.fit(x_train, y_train)
```

```
▾ KNeighborsClassifier
KNeighborsClassifier()
```

9. Validate model on test set

```
y_pred = knn.predict(x_test)
```

10. Print Classification Report on test data

```
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       0.48      0.52      0.50        25
           1       0.65      0.61      0.63        36

    accuracy                           0.57        61
   macro avg       0.56      0.57      0.56        61
weighted avg       0.58      0.57      0.58        61
```

11. Print AUC score on test data

```
roc_auc_score(y_test, y_pred)
```

```
0.5655555555555556
```

The performance of the model is vey poor. Hence hyperparameters of kNN to be tuned using GridSearchCV.

12. Hyperparameter tuning using GridSearchCV. Set the parameters a)leaf-size= 1 to 15, b)n_neighbors = 1 to 10 and c) distance metric, p = 1, 2. When p =1 its Manhattan and p = 2 its Euclidean distance. GridSearchCV uses CV to search for the optimal values of the hyperparameters. It accepts the hyperparameters as a dictionary.

```
leaf_size = list(range(1,15))
n_neighbors = list(range(1,10))
p=[1,2]
hyperparameters = dict(leaf_size=leaf_size, n_neighbors=n_neighbors, p=p)
```

13. Train a new kNN model using GridSearchCV.

```
knn_2 = KNeighborsClassifier()
clf = GridSearchCV(knn_2, hyperparameters, cv=10, scoring = 'roc_auc')
best_model = clf.fit(x,y)
```

14. Print the best values of the hyperparameters.

```
#Nilai hyperpaameters terbaik
print('Best leaf_size:', best_model.best_estimator_.get_params()['leaf_size'])
print('Best p:', best_model.best_estimator_.get_params()['p'])
print('Best n_neighbors:', best_model.best_estimator_.get_params()['n_neighbors'])
print('Best Score:', best_model.best_score_)
```

```
    Best leaf_size: 9
    Best p: 1
    Best n_neighbors: 7
    Best Score: 0.7483536683904332
```

15. Validate the model on test data

```
y_pred = best_model.predict(x_test)
```

16. Print classification report and AUC score of the model on test data

```
print(classification_report(y_test, y_pred))
print("AUC SCORE is",roc_auc_score(y_test, y_pred))
```

```
                  precision    recall  f1-score   support

               0       0.72      0.72      0.72        25
               1       0.81      0.81      0.81        36

        accuracy                           0.77        61
       macro avg       0.76      0.76      0.76        61
    weighted avg       0.77      0.77      0.77        61

    AUC SCORE is 0.7627777777777778
```