“EFFECTUAL PROPHECY OF HEART DISEASE PROGNOSIS USING MACHINE LEARNING TECHNIQUES”

IMPORTING LIBRARIES

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt#FOR PLOTING GRAPHS
from sklearn.model_selection import train_test_split # Import train_test_split function
from sklearn import svm #Import svm model
from sklearn import metrics #Import scikit-learn metrics module for accuracy calculation
from sklearn.metrics import confusion_matrix
%matplotlib inline

import os
print(os.listdir())

import warnings
warnings.filterwarnings('ignore')
from sklearn.metrics import accuracy_score
```

Loading...

```
['.config', 'ptest.csv', 'heart2.csv', 'heart1.csv', 'sample_data']
```

READ THE CSV HEART DATA BASE

```
data = pd.read_csv("/content/heart1.csv")
print(data)
```

```
      age  sex  cp  trestbps  chol  fbs  restecg  thalach  exang  oldpeak  \
0      52    1   0       125   212    0        1      168      0      1.0
1      53    1   0       140   203    1        0      155      1      3.1
2      70    1   0       145   174    0        1      125      1      2.6
3      61    1   0       148   203    0        1      161      0      0.0
4      62    0   0       138   294    1        1      106      0      1.9
...   ...  ...  ..       ...   ...  ...      ...      ...    ...      ...
1020   59    1   1       140   221    0        1      164      1      0.0
1021   60    1   0       125   258    0        0      141      1      2.8
1022   47    1   0       110   275    0        0      118      1      1.0
1023   50    0   0       110   254    0        0      159      0      0.0
1024   54    1   0       120   188    0        1      113      0      1.4

      slope  ca  thal  target
0         2   2     3       0
1         0   0     3       0
2         0   0     3       0
3         2   1     3       0
4         1   3     2       0
...     ...  ..   ...     ...
1020      2   0     2       1
1021      1   1     3       0
1022      1   1     2       0
```

```
1023       2   0      2        1
1024       1   1      3        0

[1025 rows x 14 columns]
```

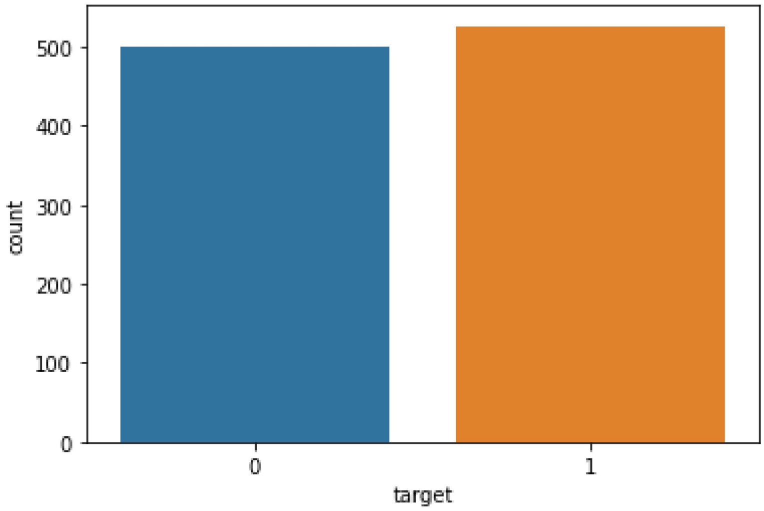
CHEACKING POSSIVE AND NEGATIVE DATA POINTS IN DATABASE

```
y = data["target"]

sns.countplot(y)
```

Loading...

```
target_temp = data.target.value_counts()

print(target_temp)
```

```
1    526
0    499
Name: target, dtype: int64
```



PRINTING THE FIRST 5 DATA POINTS

```
data.head()
```

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	th
0	52	1	0	125	212	0	1	168	0	1.0	2	2	
1	53	1	0	140	203	1	0	155	1	3.1	0	0	
2	70	1	0	145	174	0	1	125	1	2.6	0	0	
3	61	1	0	148	203	0	1	161	0	0.0	2	1	
4	62	0	0	138	294	1	1	106	0	1.9	1	3	

DESCRIBE THE DATABASE

```
data.describe()
```

	age	sex	cp	trestbps	chol	fbs	
count	1025.000000	1025.000000	1025.000000	1025.000000	1025.00000	1025.000000	10:
mean	54.434146	0.695610	0.942439	131.611707	246.00000	0.149268	
std	9.072290	0.460373	1.029641	17.516718	51.59251	0.356527	
min	29.000000	0.000000	0.000000	94.000000	126.00000	0.000000	
25%	48.000000	0.000000	0.000000	120.000000	211.00000	0.000000	
50%	56.000000	1.000000	1.000000	130.000000 Loading...	240.00000	0.000000	
75%	61.000000	1.000000	2.000000	140.000000	275.00000	0.000000	
max	77.000000	1.000000	3.000000	200.000000	564.00000	1.000000	

READIONG THE INFORMATION

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1025 entries, 0 to 1024
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       1025 non-null   int64  
 1   sex       1025 non-null   int64  
 2   cp        1025 non-null   int64  
 3   trestbps  1025 non-null   int64  
 4   chol      1025 non-null   int64  
 5   fbs       1025 non-null   int64  
 6   restecg   1025 non-null   int64  
 7   thalach   1025 non-null   int64  
 8   exang     1025 non-null   int64  
 9   oldpeak   1025 non-null   float64
 10  slope     1025 non-null   int64  
 11  ca        1025 non-null   int64  
 12  thal      1025 non-null   int64  
 13  target    1025 non-null   int64  
dtypes: float64(1), int64(13)
memory usage: 112.2 KB
```

FINDING THE SIZE OF DATA

```
data.shape
```

```
(1025, 14)
```

SPLITTING OUTPUT AND INPUT

```
x = data.drop('target',axis = 1)
y = data.target
print(x)
print("\n\n\n")
print(y)
```

```
      age  sex  cp  trestbps  chol  fbs  restecg  thalach  exang  oldpeak  \
0      52    1   0       125   212    0        1      168      0      1.0
1      53    1   0       140   203    1        0      155      1      3.1
2      70    1   0       145   174    0        1      125      1      2.6
3      61    1   0       148   203    0        1      161      0      0.0
4      62    0   0       138   294    1        1      106      0      1.9
...   ...  ...  ..       ...   ...  ...      ...      ...    ...      ...
1020   59    1   1       140   221    0        1      164      1      0.0
1021   60    1   0       125   258    0        0      141      1      2.8
1022   47    1   0       110   275    0        0      118      1      1.0
1023   50    0   0       110   254    0        0      159      0      0.0
1024   54    1   0       120   188    0        1      113      0      1.4

      slope  ca  thal
0         2   2     3
1         0   0     3
2         0   0     3
3         2   1     3
4         1   3     2
...     ...  ..   ...
1020      2   0     2
1021      1   1     3
1022      1   1     2
1023      2   0     2
1024      1   1     3

[1025 rows x 13 columns]




0       0
1       0
2       0
3       0
4       0
       ..
1020    1
1021    0
1022    0
1023    1
1024    0
Name: target, Length: 1025, dtype: int64
```

70% training and 30% test

```
x_train, x_test, y_train, y_test = train_test_split(x, y, train_size=0.7,random_state=109)
```

```
print(x_train)
print('\n')
print(y_train)
print('\n')
print(x_test)
print('\n')
print(y_test)
```

```
[717 rows x 13 columns]


301     1
891     1
739     0
19      1
841     1
       ..
801     1
587     0
399     1
1008    1
141     0
Name: target, Length: 717, dtype: int64


     age  sex  cp  trestbps  chol  fbs  restecg  thalach  exang  oldpeak  \
297   58    1   0       150   270    0        0      111      1      0.8
215   49    1   1       130   266    0        1      171      0      0.6
224   51    1   0       140   261    0        0      186      1      0.0
912   35    1   0       120   198    0        1      130      1      1.6
361   62    1   2       130   231    0        1      146      0      1.8
..   ...  ...  ..       ...   ...  ...      ...      ...    ...      ...
513   54    1   0       110   206    0        0      108      1      0.0
494   51    1   2       125   245    1        0      166      0      2.4
168   43    1   2       130   315    0        1      162      0      1.9
911   58    0   1       136   319    1        0      152      0      0.0
279   41    0   1       105   198    0        1      168      0      0.0

     slope  ca  thal
297      2   0     3
215      2   0     2
224      2   0     2
912      1   0     3
361      1   3     3
..     ...  ..   ...
513      1   1     2
494      1   0     2
168      2   1     2
911      2   2     2
279      2   1     2

[308 rows x 13 columns]


297    0
215    1
224    1
912    0
361    1
      ..
```

Loading...

```
    513    0
    494    1
    168    1
    911    0
    279    1
    Name: target, Length: 308, dtype: int64
```

SUPPORT VECTOR MACHINE

LINEAR SVM

Loading...

```
#Create a svm Classifier
ml = svm.SVC(kernel='linear') # Linear Kernel

#Train the model using the training sets
ml.fit(x_train, y_train)


#Predict the response for test dataset
y_pred = ml.predict(x_test)
y_pred
```

```
    array([0, 1, 1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1,
           1, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1,
           0, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 1,
           0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1,
           0, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0,
           1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1,
           1, 1, 0, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1,
           1, 1, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0,
           0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1,
           0, 0, 1, 1, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1,
           0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1,
           0, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1,
           1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1,
           1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1])
```

ACCURACY OF LINEAR SVM

```
ml.score(x_test,y_test)
```

```
    0.8733766233766234
```

```
confusion_matrix(y_test,y_pred)
```

```
    array([[124,  26],
           [ 13, 145]])
```

POLYNOMIAL SVM

```
#Create a svm Classifier
ml = svm.SVC(kernel='poly',C=1000,degree=3) # polynomial

#Train the model using the training sets
ml.fit(x_train, y_train)

#Predict the response for test dataset
y_pred = ml.predict(x_test)
```

ACCURACY OF POLYNOMIAL SVM

Loading...

```
ml.score(x_test,y_test)
```

```
0.8766233766233766
```

```
confusion_matrix(y_test,y_pred)
```

```
array([[123,  27],
       [ 11, 147]])
```

RADIAL BASIS FUNCTION SVM

```
#Create a svm Classifier
ml = svm.SVC(kernel='rbf',gamma=10,C=1000) # RBF

#Train the model using the training sets
ml.fit(x_train, y_train)

#Predict the response for test dataset
y_pred = ml.predict(x_test)
```

ACCURACY OF RADIAL BASIS FUNCTION SVM

```
ml.score(x_test,y_test)
```

```
0.9772727272727273
```

```
confusion_matrix(y_test,y_pred)
```

```
array([[143,   7],
       [  0, 158]])
```

DECISION TREE

```
from sklearn.tree import DecisionTreeClassifier
```

```
max_accuracy = 0
```

```
for x in range(200):
    dt = DecisionTreeClassifier(random_state=x)
    dt.fit(x_train,y_train)
    Y_pred_dt = dt.predict(x_test)
    current_accuracy = round(accuracy_score(Y_pred_dt,y_test)*100,2)
    if(current_accuracy>max_accuracy):
        max_accuracy = current_accuracy
        best_x = x

#print(max_accuracy)
#print(best_x)
```

Loading...

```
dt = DecisionTreeClassifier(random_state=best_x)
dt.fit(x_train,y_train)
Y_pred_dt = dt.predict(x_test)
```

ACCURACY OF DECISION TREE

```
score_dt = round(accuracy_score(Y_pred_dt,y_test)*100,2)

print("The accuracy score achieved using Decision Tree is: "+str(score_dt)+" %")
```

```
The accuracy score achieved using Decision Tree is: 99.03 %
```

RANDOM FOREST

```
from sklearn.ensemble import RandomForestClassifier

max_accuracy = 0


for x in range(200):
    rf= RandomForestClassifier(random_state=x)
    rf.fit(x_train,y_train)
    Y_pred_rf = rf.predict(x_test)
    current_accuracy = round(accuracy_score(Y_pred_rf,y_test)*100,2)
    if(current_accuracy>max_accuracy):
        max_accuracy = current_accuracy
        best_x = x

print(max_accuracy)
print(best_x)

rf = RandomForestClassifier(random_state=best_x)
rf.fit(x_train,y_train)
Y_pred_rf = rf.predict(x_test)
```

```
99.03
```

```
     0
```

ACCURACY OF RANDOM FOREST

```
score_rf = round(accuracy_score(Y_pred_rf,y_test)*100,2)

print("The accuracy score achieved using Decision Tree is: "+str(score_rf)+" %")
```

```
     The accuracy score achieved using Decision Tree is: 99.03 %
```

K NEAREST NEIGHBOR

Loading...

```
from sklearn.neighbors import KNeighborsClassifier
max_accuracy=0
bk=0

for k in range(300):
    if k==0:
      continue
    knn = KNeighborsClassifier(n_neighbors=k)
    knn.fit(x_train,y_train)
    Y_pred_dt = knn.predict(x_test)
    current_accuracy = round(accuracy_score(Y_pred_dt,y_test)*100,2)
    if(current_accuracy>max_accuracy):
        max_accuracy = current_accuracy
        bk= k

knn = KNeighborsClassifier(n_neighbors=bk)
knn.fit(x_train,y_train)
Y_pred_knn=knn.predict(x_test)
```

ACCURACY OF K NEAREST NEIGHBOR

```
score_knn = round(accuracy_score(Y_pred_knn,y_test)*100,2)

print("The accuracy score achieved using KNN is: "+str(score_knn)+" %")
```

```
     The accuracy score achieved using KNN is: 97.08 %
```

FINDING TEST ACCURASY FOR NEW UNSEEN 303 DATA IN A DIFFRENT DATASET

```
testdata=pd.read_csv("/content/heart2.csv")
x_newdata=testdata.drop('target',axis=1)
y_accual=testdata.target
```

```
y_pred=ml.predict(x_newdata)
y_accual
```

```
confusion_matrix(y_accual,y_pred)
```

```
array([[136,   2],
       [  0, 165]])
```

SVM TEST ACCURACY WITH NEW DATABASE 97.7%

```
y_predrf=rf.predict(x_newdata)
confusion_matrix(y_accual,y_predrf)
```

```
array([[138,   0],
       [  1, 164]])
```

Loading...

THE TEST ACCURACY OF RF FOR NEW UNSEEN DATA IS 99.6%

```
y_predknn=dt.predict(x_newdata)
print(y_predknn)
print('\n\n')
print(y_accual)

confusion_matrix(y_accual,y_predknn)
```

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



0      1
1      1
2      1
3      1
4      1
      ..
298    0
299    0
300    0
301    0
302    0
Name: target, Length: 303, dtype: int64
array([[138,   0],
       [  1, 164]])
```

SO, THE TEST ACCURACY FOR DECISION TREE FOR NEW DATA SET IS 99.66%

```
y_predknn=knn.predict(x_newdata)
confusion_matrix(y_accual,y_predknn)
```

```
array([[137,   1],
       [  2, 163]])
```

THE TEST ACCURACY OF KNN FOR UNSEEN DATASET IS 99%

TEST SINGLE PERSON DATA

```
print("enter the patient data (13 attributes )")
pdata=pd.read_csv("/content/ptest.csv")
y_prednt=dt.predict(pdata)
print(y_prednt)
print('\n')
if y_prednt[0]==0:
  print("The patient has no heart disease")
else:
  print("The patient have heart disease")
```

Loading...

```
enter the patient data (13 attributes )
[0]


The patient has no heart disease
```

```
print("Enter the patient data (13 attributes )")
dist={}
dist["age"]=int(input("enter your age: "))
dist["sex"]=int(input("enter your sex (0-female 1-for male: "))
dist["cp"]=int(input("enter cp value: "))
dist["trestbps"]=int(input("enter trestbps: "))
dist["chol"]=int(input("enter chol: "))
dist["fbs"]=int(input("enter fbs value: "))
dist["restecg"]=int(input("enter restecg: "))
dist["thalach"]=int(input("enter thalach: "))
dist["exang"]=int(input("enter exang: "))
dist["old peak"]=float(input("enter oldpeak: "))
dist["slop"]=int(input("enter slop: "))
dist["ca"]=int(input("enter ca: "))
dist["thal"]=int(input("enter thal: "))
df=pd.DataFrame(dist,index=[0])
print(df)
print('\n')

y_prednt=dt.predict(df)
print(y_prednt)
print('\n')

if y_prednt[0]==0:
  print("The patient has no heart disease")
else:
  print("The patient have heart disease")
```

```
Enter the patient data (13 attributes )
enter your age: 52
enter your sex (0-female 1-for male: 1
enter cp value: 0
enter trestbps: 125
enter chol: 212
enter fbs value: 0
enter restecg: 1
enter thalach: 168
enter exang: 0
enter oldpeak: 1
enter slop: 2
enter ca: 2
enter thal: 3
   age  sex  cp  trestbps  chol  fbs  restecg  thalach  exang  old peak  slop  \
0   52    1   0       125   212    0        1      168      0       1.0     2

   ca  thal
0   2     3


[0]


The patient has no heart disease
```

✓ 1m 56s completed at 12:22 AM