TITLE - Heart Disease Prediction

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Explanation – The Objective of this project is to create a model that can predict the patient's heart disease Status.Another Objective is to explore the data we have been given and find key insights into Heart Disease that could be helpful for the Medical community going forward. Dataset for this project is taken from Kaggle website https://www.kaggle.com/datasets/priyanka841/heart-disease-prediction-uci .Here we use Logistic Regression model.In this Dataset there are 303 Rows and 14 Columns, means 302 Persons Data out of which 241 are use for Training the Data and 61 use for Testing the Data.

```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score
import matplotlib.pyplot as plt
```

Data Collection and Processing

```
 #loading the csv data to a Pandas DataFrame
heart_data = pd.read_csv('/content/heart disease.csv')

# print first 5 rows of the dataset
heart_data.head()
```

```
   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
```

```
# print last 5 rows of the dataset
heart_data.tail()
```

```
     age  sex  cp  trestbps  chol  fbs  restecg  thalach  exang
oldpeak  \
298   57    0   0       140   241    0        1      123      1
0.2
299   45    1   3       110   264    0        1      132      0
1.2
300   68    1   0       144   193    1        1      141      0
3.4
301   57    1   0       130   131    0        1      115      1
1.2
302   57    0   1       130   236    0        0      174      0
0.0

     slope  ca  thal  target
298      1   0     3       0
299      1   0     3       0
300      1   2     3       0
301      1   1     3       0
302      1   1     2       0
```

```
# number of rows and columns in the dataset
heart_data.shape
```

```
(303, 14)
```

```
# getting some info about the data
heart_data.info()
```

```
<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
```

```
# checking for missing values
heart_data.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
```

```
# statistical measures about the data
heart_data.describe()
```

```
              age         sex          cp    trestbps        chol
fbs  \
count  303.000000  303.000000  303.000000  303.000000  303.000000
303.000000
mean    54.366337    0.683168    0.966997  131.623762  246.264026
0.148515
std      9.082101    0.466011    1.032052   17.538143   51.830751
0.356198
min     29.000000    0.000000    0.000000   94.000000  126.000000
0.000000
25%     47.500000    0.000000    0.000000  120.000000  211.000000
0.000000
50%     55.000000    1.000000    1.000000  130.000000  240.000000
0.000000
75%     61.000000    1.000000    2.000000  140.000000  274.500000
0.000000
max     77.000000    1.000000    3.000000  200.000000  564.000000
1.000000

          restecg     thalach       exang     oldpeak       slope
```

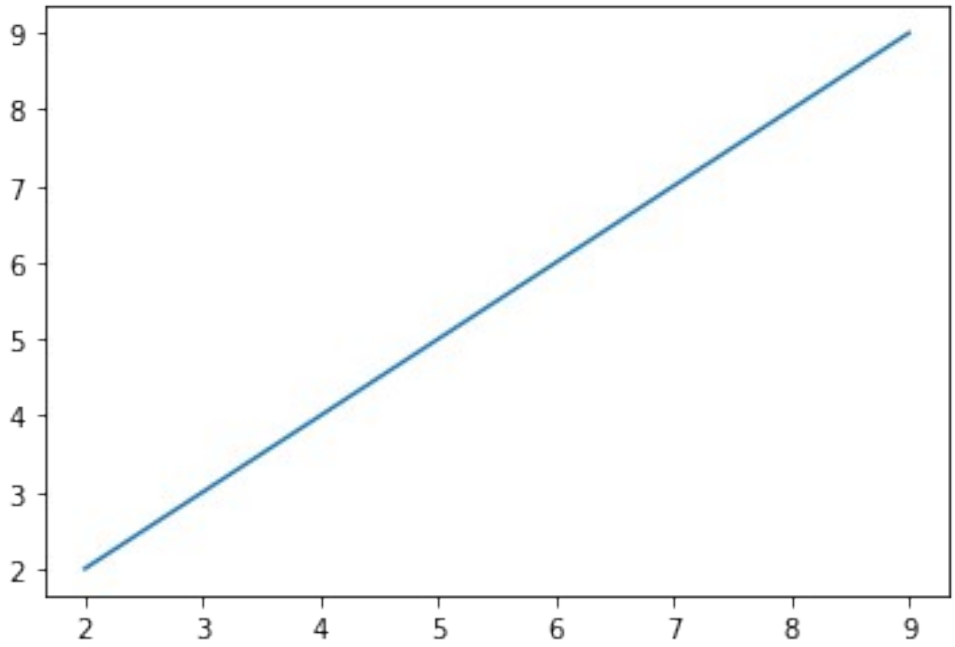
```
ca  \
count  303.000000  303.000000  303.000000  303.000000  303.000000
303.000000
mean     0.528053  149.646865    0.326733    1.039604    1.399340
0.729373
std      0.525860   22.905161    0.469794    1.161075    0.616226
1.022606
min      0.000000   71.000000    0.000000    0.000000    0.000000
0.000000
25%      0.000000  133.500000    0.000000    0.000000    1.000000
0.000000
50%      1.000000  153.000000    0.000000    0.800000    1.000000
0.000000
75%      1.000000  166.000000    1.000000    1.600000    2.000000
1.000000
max      2.000000  202.000000    1.000000    6.200000    2.000000
4.000000

             thal      target
count  303.000000  303.000000
mean     2.313531    0.544554
std      0.612277    0.498835
min      0.000000    0.000000
25%      2.000000    0.000000
50%      2.000000    1.000000
75%      3.000000    1.000000
max      3.000000    1.000000
```

Data Visualization

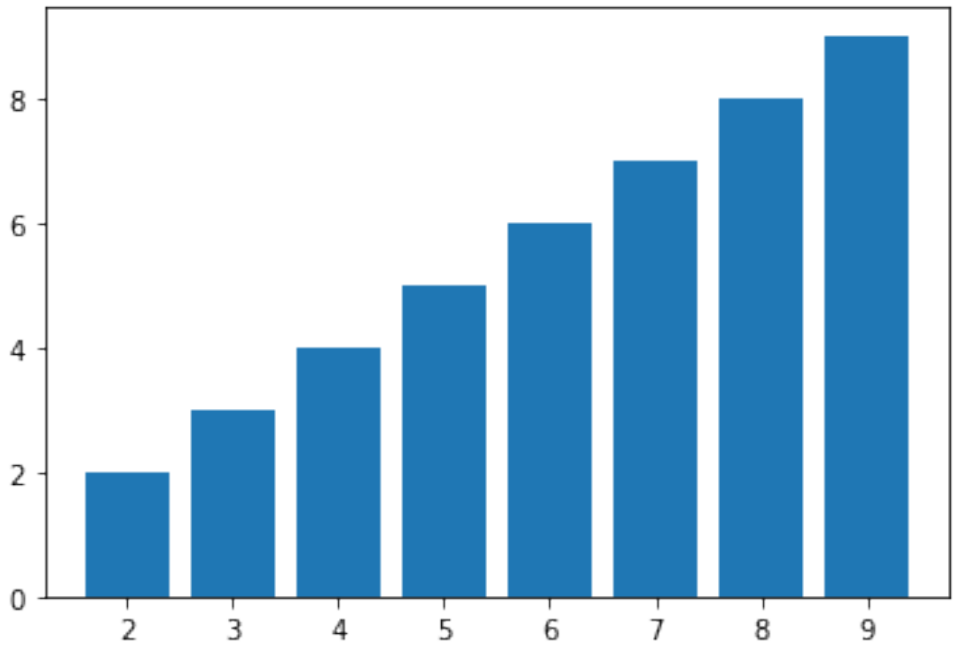
```
x = [2,3,4,5,6,7,8,9]
y = [2,3,4,5,6,7,8,9]

fig, ax = plt.subplots()
ax.plot(x,y);
```




```
fig, ax = plt.subplots()

ax.bar(x,y);
```




```
fig, ax = plt.subplots()

ax.pie(y);
```

```
# checking the distribution of Target Variable
heart_data['target'].value_counts()
```

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

Splitting the Features and Target

```
X = heart_data.drop(columns='target', axis=1)
Y = heart_data['target']
```

```
print(X)
```

```
     age  sex  cp  trestbps  chol  fbs  restecg  thalach  exang
oldpeak  \
0     63    1   3       145   233    1        0      150      0
2.3
1     37    1   2       130   250    0        1      187      0
3.5
2     41    0   1       130   204    0        0      172      0
1.4
3     56    1   1       120   236    0        1      178      0
0.8
4     57    0   0       120   354    0        1      163      1
0.6
..   ...  ...  ..       ...   ...  ...      ...      ...    ...      .
..
298   57    0   0       140   241    0        1      123      1
0.2
299   45    1   3       110   264    0        1      132      0
1.2
```

```
300   68    1   0       144   193    1        1      141      0
3.4
301   57    1   0       130   131    0        1      115      1
1.2
302   57    0   1       130   236    0        0      174      0
0.0

     slope  ca  thal
0        0   0     1
1        0   0     2
2        2   0     2
3        2   0     2
4        2   0     2
..     ...  ..   ...
298      1   0     3
299      1   0     3
300      1   2     3
301      1   1     3
302      1   1     2

[303 rows x 13 columns]
```

```
print(Y)
```

```
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
```

Splitting the Data into Training data & Test Data

```
X_train, X_test, Y_train, Y_test = train_test_split(X, Y,
test_size=0.2, stratify=Y, random_state=2)
```

```
print(X.shape, X_train.shape, X_test.shape)
```

```
(303, 13) (242, 13) (61, 13)
```

Model Training 1

Logistic Regression

```
model = LogisticRegression()
```

```
# training the LogisticRegression model with Training data
model.fit(X_train, Y_train)
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/linear_model/
_logistic.py:818: 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
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG,
```

```
LogisticRegression()
```

Model Evaluation 1

Accuracy Score

```
# accuracy on training data
X_train_prediction = model.predict(X_train)
training_data_accuracy = accuracy_score(X_train_prediction, Y_train)
```

```
print('Accuracy on Training data : ', training_data_accuracy)
```

```
Accuracy on Training data :  0.8512396694214877
```

```
# accuracy on test data
X_test_prediction = model.predict(X_test)
test_data_accuracy = accuracy_score(X_test_prediction, Y_test)
```

```
print('Accuracy on Test data : ', test_data_accuracy)
```

```
Accuracy on Test data :  0.819672131147541
```

Model Training 2

RANDOM FOREST CLASSIFIER

```
from sklearn.ensemble import RandomForestClassifier
```

```
model = RandomForestClassifier()
```

```
model.fit(X_train, Y_train)
```

```
RandomForestClassifier()
```

Model Evaluation 2

Accuracy Score

```
# accuracy on training data
X_train_prediction = model.predict(X_train)
training_data_accuracy = accuracy_score(X_train_prediction, Y_train)

print('Accuracy on Training data : ', training_data_accuracy)
```

```
Accuracy on Training data :  1.0
```

```
# accuracy on test data
X_test_prediction = model.predict(X_test)
test_data_accuracy = accuracy_score(X_test_prediction, Y_test)

print('Accuracy on Test data : ', test_data_accuracy)
```

```
Accuracy on Test data :  0.819672131147541
```

Building a Predictive System

```
input_data = (62,0,0,140,268,0,0,160,0,3.6,0,2,2)

# change the input data to a numpy array
input_data_as_numpy_array= np.asarray(input_data)

# reshape the numpy array as we are predicting for only on instance
input_data_reshaped = input_data_as_numpy_array.reshape(1,-1)

prediction = model.predict(input_data_reshaped)
print(prediction)

if (prediction[0]== 0):
  print('The Person does not have a Heart Disease')
else:
  print('The Person has Heart Disease')
```

```
[0]
The Person does not have a Heart Disease

/usr/local/lib/python3.7/dist-packages/sklearn/base.py:451:
UserWarning: X does not have valid feature names, but
RandomForestClassifier was fitted with feature names
  "X does not have valid feature names, but"
```