1. Importing the Libraries

Here , we are importing all the necassary libraries that will be used in the project

In [59]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")
```

2. Importing the Dataset

Here , the dataset is used is heart.csv which is taken from kaggle.com Link - [https://www.kaggle.com/rashikrahmanpritom/heart-attack-analysis-prediction-dataset (https://www.kaggle.com/rashikrahmanpritom/heart-attack-analysis-prediction-dataset)](https://www.kaggle.com/rashikrahmanpritom/heart-attack-analysis-prediction-dataset)

In [2]:

```
df = pd.read_csv('heart.csv')
df.head()
```

Out[2]:

	age	sex	cp	trtbps	chol	fbs	restecg	thalachh	exng	oldpeak	slp	caa	thall	output
0	63	1	3	145	233	1	0	150	0	2.3	0	0	1	1
1	37	1	2	130	250	0	1	187	0	3.5	0	0	2	1
2	41	0	1	130	204	0	0	172	0	1.4	2	0	2	1
3	56	1	1	120	236	0	1	178	0	0.8	2	0	2	1
4	57	0	0	120	354	0	1	163	1	0.6	2	0	2	1

Data Preprocessing - Data preprocessing can refer to manipulation or dropping of data before it is used in order to ensure or enhance performance, and is an important step in the data mining process

3. Taking Care of Missing Values

In [3]:

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

Out[3]:

```
age         0
sex         0
cp          0
trtbps      0
chol        0
fbs         0
restecg     0
thalachh    0
exng        0
oldpeak     0
slp         0
caa         0
thall       0
output      0
dtype: int64
```

4. Taking Care of Duplicate Values

In [143]:

```
df.duplicated().any()
```

Out[143]:

```
True
```

In [10]:
```
df = df.drop_duplicates()
df.head(4)
```

Out[10]:

	age	sex	cp	trtbps	chol	fbs	restecg	thalachh	exng	oldpeak	slp	caa	thall	output
0	63	1	3	145	233	1	0	150	0	2.3	0	0	1	1
1	37	1	2	130	250	0	1	187	0	3.5	0	0	2	1
2	41	0	1	130	204	0	0	172	0	1.4	2	0	2	1
3	56	1	1	120	236	0	1	178	0	0.8	2	0	2	1

In [146]:
```
df.columns
```

Out[146]:
```
Index(['age', 'sex', 'cp', 'trtbps', 'chol', 'fbs', 'restecg', 'thalachh',
       'exng', 'oldpeak', 'slp', 'caa', 'thall', 'output'],
      dtype='object')
```

5. Data Processing

In [5]:
```
cate_val = []
cont_val = []
for column in df.columns:
    if df[column].nunique() <=10:
        cate_val.append(column)
    else:
        cont_val.append(column)
```

In [6]:
```
cate_val
```

Out[6]:
```
['sex', 'cp', 'fbs', 'restecg', 'exng', 'slp', 'caa', 'thall', 'output']
```

In [7]:
```
cont_val
```

Out[7]:
```
['age', 'trtbps', 'chol', 'thalachh', 'oldpeak']
```

7. Feature Scaling

In [12]:
```
from sklearn.preprocessing import StandardScaler
```

In [13]:
```
st = StandardScaler()
df[cont_val] = st.fit_transform(df[cont_val])
```

In [14]:
```
df.head()
```

Out[14]:

	age	sex	cp	trtbps	chol	fbs	restecg	thalachh	exng	oldpeak	slp	caa	thall	output
0	0.949794	1	3	0.764066	-0.261285	1	0	0.018826	0	1.084022	0	0	1	1
1	-1.928548	1	2	-0.091401	0.067741	0	1	1.636979	0	2.118926	0	0	2	1
2	-1.485726	0	1	-0.091401	-0.822564	0	0	0.980971	0	0.307844	2	0	2	1
3	0.174856	1	1	-0.661712	-0.203222	0	1	1.243374	0	-0.209608	2	0	2	1
4	0.285561	0	0	-0.661712	2.080602	0	1	0.587366	1	-0.382092	2	0	2	1

8. Splitting The Dataset Into The Training Set And Test Set

In [15]:
```
X = df.drop(df[cate_val] , axis=1)
```

In [16]:
```
y = df['output']
```

In [17]:
```
from sklearn.model_selection import train_test_split
```

In [18]:
```
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2,
                                               random_state=42)
```

```
In [19]: y_test
```

```
Out[19]: 180    0
         229    0
         111    1
         247    0
         60     1
               ..
         250    0
         104    1
         300    0
         194    0
         185    0
         Name: output, Length: 61, dtype: int64
```

Using the Various Classification Model to predict the Output values -

9. Logistic Regression - Logistic regression is a process of modeling the probability of a discrete outcome given an input variable. The most common logistic regression models a binary outcome; something that can take two values such as true/false, yes/no, and so on.

```
In [20]: df.head(5)
```

Out[20]:

	age	sex	cp	trtbps	chol	fbs	restecg	thalachh	exng	oldpeak	slp	caa	thall	output
0	0.949794	1	3	0.764066	-0.261285	1	0	0.018826	0	1.084022	0	0	1	1
1	-1.928548	1	2	-0.091401	0.067741	0	1	1.636979	0	2.118926	0	0	2	1
2	-1.485726	0	1	-0.091401	-0.822564	0	0	0.980971	0	0.307844	2	0	2	1
3	0.174856	1	1	-0.661712	-0.203222	0	1	1.243374	0	-0.209608	2	0	2	1
4	0.285561	0	0	-0.661712	2.080602	0	1	0.587366	1	-0.382092	2	0	2	1

```
In [21]: from sklearn.linear_model import LogisticRegression
```

```
In [22]: log = LogisticRegression()
         log.fit(X_train,y_train)
```

```
Out[22]: LogisticRegression()
```

```
In [23]: y_pred1 = log.predict(X_test)
```

```
In [24]: from sklearn.metrics import accuracy_score
```

```
In [25]: accuracy_score(y_test,y_pred1)*100
```

```
Out[25]: 78.68852459016394
```

```
In [ ]:
```

10. SVM - A support vector machine (SVM) is a supervised machine learning algorithm that solves two-group classification problems. After giving an SVM model sets of labeled training data for each category, they're able to categorize new text.

```
In [26]: from sklearn import svm
```

```
In [27]: svm = svm.SVC()
```

```
In [28]: svm.fit(X_train,y_train)
```

```
Out[28]: SVC()
```

```
In [29]: y_pred2 = svm.predict(X_test)
```

```
In [30]: accuracy_score(y_test,y_pred2)*100
```

```
Out[30]: 77.04918032786885
```

```
In [ ]:
```

11. KNeighbors Classifier - K-NN classification with K-means clustering. KNN is a supervised classification algorithm that classifies new data points based on the nearest data points

```
In [31]: from sklearn.neighbors import KNeighborsClassifier
```

```
In [32]: knn = KNeighborsClassifier()
```

```
In [33]: knn.fit(X_train,y_train)

Out[33]: KNeighborsClassifier()
```

```
In [34]: y_pred3=knn.predict(X_test)
```

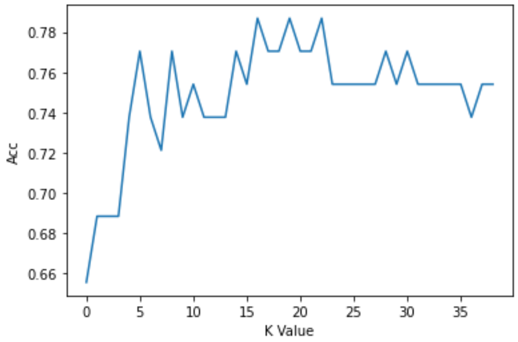
```
In [35]: accuracy_score(y_test,y_pred3)

Out[35]: 0.7377049180327869
```

```
In [36]: score = []

         for k in range(1,40):
             knn=KNeighborsClassifier(n_neighbors=k)
             knn.fit(X_train,y_train)
             y_pred=knn.predict(X_test)
             score.append(accuracy_score(y_test,y_pred))
```

```
In [37]: score

Out[37]: [0.6557377049180327,
          0.6885245901639344,
          0.6885245901639344,
          0.6885245901639344,
          0.7377049180327869,
          0.7704918032786885,
          0.7377049180327869,
          0.7213114754098361,
          0.7704918032786885,
          0.7377049180327869,
          0.7540983606557377,
          0.7377049180327869,
          0.7377049180327869,
          0.7377049180327869,
          0.7704918032786885,
          0.7540983606557377,
          0.7868852459016393,
          0.7704918032786885,
          0.7704918032786885,
          0.7868852459016393,
          0.7704918032786885,
          0.7704918032786885,
          0.7868852459016393,
          0.7540983606557377,
          0.7540983606557377,
          0.7540983606557377,
          0.7540983606557377,
          0.7540983606557377,
          0.7704918032786885,
          0.7540983606557377,
          0.7704918032786885,
          0.7540983606557377,
          0.7540983606557377,
          0.7540983606557377,
          0.7540983606557377,
          0.7540983606557377,
          0.7377049180327869,
          0.7540983606557377,
          0.7540983606557377]
```

In [38]:

```
plt.plot(score)
plt.xlabel("K Value")
plt.ylabel("Acc")
plt.show()
```



In [39]:

```
knn=KNeighborsClassifier(n_neighbors=2)
knn.fit(X_train,y_train)
y_pred=knn.predict(X_test)
accuracy_score(y_test,y_pred)*100
```

Out[39]:

```
68.85245901639344
```

Non-Linear ML Algorithms - Non-Linear regression is a type of polynomial regression. It is a method to model a non-linear relationship between the dependent and independent variables. It is used in place when the data shows a curvy trend, and linear regression would not produce very accurate results when compared to non-linear regression.

12. Decision Tree Classifier

In [40]:

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

In [41]:

```
dt = DecisionTreeClassifier()
```

In [42]:

```
dt.fit(X_train,y_train)
```

Out[42]:

```
DecisionTreeClassifier()
```

In [43]:

```
y_pred4= dt.predict(X_test)
```

In [44]:

```
accuracy_score(y_test,y_pred4)
```

Out[44]:

```
0.6557377049180327
```

13. Random Forest Classifier

In [45]:

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

In [46]:

```
rf = RandomForestClassifier()
```

In [47]:

```
rf.fit(X_train,y_train)
```

Out[47]:

```
RandomForestClassifier()
```

In [48]:

```
y_pred5= rf.predict(X_test)
```

In [49]:

```
accuracy_score(y_test,y_pred5)
```

Out[49]:

```
0.7540983606557377
```

14. Gradient Boosting Classifier

In [50]:

```
from sklearn.ensemble import GradientBoostingClassifier
```

In [51]:
```
gbc = GradientBoostingClassifier()
```

In [52]:
```
gbc.fit(X_train,y_train)
```

Out[52]:
```
GradientBoostingClassifier()
```

In [53]:
```
y_pred6 = gbc.predict(X_test)
```

In [54]:
```
accuracy_score(y_test,y_pred6)
```

Out[54]:
```
0.7704918032786885
```

All Models and their Accuracy-Scores

In [57]:
```
final_data = pd.DataFrame({'Models':['LR','SVM','KNN','DT','RF','GB'],
                           'ACC':[accuracy_score(y_test,y_pred1)*100,
                                 accuracy_score(y_test,y_pred2)*100,
                                 accuracy_score(y_test,y_pred3)*100,
                                 accuracy_score(y_test,y_pred4)*100,
                                 accuracy_score(y_test,y_pred5)*100,
                                 accuracy_score(y_test,y_pred6)*100]})
```

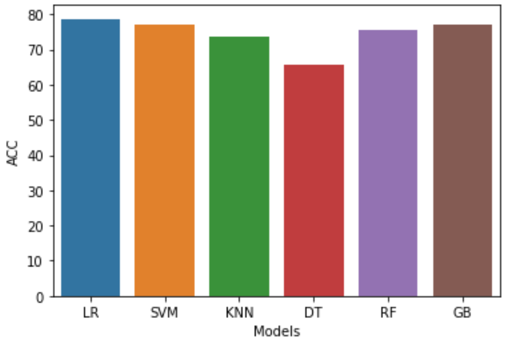
In [58]:
```
final_data
```

Out[58]:

	Models	ACC
0	LR	78.688525
1	SVM	77.049180
2	KNN	73.770492
3	DT	65.573770
4	RF	75.409836
5	GB	77.049180

In [60]:
```
sns.barplot(final_data['Models'],final_data['ACC'])
```

Out[60]:
```
<AxesSubplot:xlabel='Models', ylabel='ACC'>
```



In [62]:
```
df[cate_val]
```

Out[62]:

	sex	cp	fbs	restecg	exng	slp	caa	thall	output
0	1	3	1	0	0	0	0	1	1
1	1	2	0	1	0	0	0	2	1
2	0	1	0	0	0	2	0	2	1
3	1	1	0	1	0	2	0	2	1
4	0	0	0	1	1	2	0	2	1
...	...	...	...	...	...	...	...	...	...
298	0	0	0	1	1	1	0	3	0
299	1	3	0	1	0	1	0	3	0
300	1	0	1	1	0	1	2	3	0
301	1	0	0	1	1	1	1	3	0
302	0	1	0	0	0	1	1	2	0

302 rows × 9 columns

In [73]:
```
cols = df.columns
features = cols[:-1]
features
```

Out[73]:
```
Index(['age', 'sex', 'cp', 'trtbps', 'chol', 'fbs', 'restecg', 'thalachh',
       'exng', 'oldpeak', 'slp', 'caa', 'thall'],
      dtype='object')
```

In [77]:
```
X_new = df[features]
y_new = df['output']
print(X_new , y_new )
```

```
          age  sex  cp    trtbps      chol  fbs  restecg  thalachh  exng  \
0    0.949794    1   3  0.764066 -0.261285    1        0  0.018826     0   
1   -1.928548    1   2 -0.091401  0.067741    0        1  1.636979     0   
2   -1.485726    0   1 -0.091401 -0.822564    0        0  0.980971     0   
3    0.174856    1   1 -0.661712 -0.203222    0        1  1.243374     0   
4    0.285561    0   0 -0.661712  2.080602    0        1  0.587366     1   
..        ...  ...  ..       ...       ...  ...      ...       ...   ...   
298  0.285561    0   0  0.478910 -0.106449    0        1 -1.161988     1   
299 -1.042904    1   3 -1.232023  0.338703    0        1 -0.768384     0   
300  1.503322    1   0  0.707035 -1.035462    1        1 -0.374779     0   
301  0.285561    1   0 -0.091401 -2.235438    0        1 -1.511859     1   
302  0.285561    0   1 -0.091401 -0.203222    0        0  1.068439     0   

      oldpeak  slp  caa  thall  
0    1.084022    0    0      1  
1    2.118926    0    0      2  
2    0.307844    2    0      2  
3   -0.209608    2    0      2  
4   -0.382092    2    0      2  
..        ...  ...  ...    ...  
298 -0.727060    1    0      3  
299  0.135360    1    0      3  
300  2.032684    1    2      3  
301  0.135360    1    1      3  
302 -0.899544    1    1      2  

[302 rows x 13 columns] 0      1
1      1
2      1
3      1
4      1
      ..
298    0
299    0
300    0
301    0
302    0
Name: output, Length: 302, dtype: int64
```

Random Forest Classifier

In [78]:
```
from sklearn.ensemble import RandomForestClassifier
```

In [82]:
```
rf = RandomForestClassifier()
rf.fit(X_new,y_new)
```

Out[82]:
```
RandomForestClassifier()
```

Test Data values for the Random Forest for prediction of the heart diseases

In [83]:
```
new_data1 = pd.DataFrame({
    'age':52,
    'sex':1,
    'cp':0,
    'trtbps':125,
    'chol':212,
    'fbs':0,
    'restecg':1,
    'thalachh':168,
    'exng':0,
    'oldpeak':1.0,
     'slp':2,
    'caa':2,
    'thall':3,
},index=[0])
```

```
In [84]: rf.predict(new_data1)
```

```
Out[84]: array([0], dtype=int64)
```

15. Prediction on New Data

Creating a data - frame of the new test data

```
In [85]: test_df = pd.DataFrame(new_data1 , index = [0])
         test_df
```

Out[85]:

	age	sex	cp	trtbps	chol	fbs	restecg	thalachh	exng	oldpeak	slp	caa	thall
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3

```
In [87]: p = rf.predict(test_df)
         print(p)
         if p[0]==0:
             print("No Disease")
         else:
             print("Disease")
```

```
[0]
No Disease
```

16. Save Model Using Joblib

```
In [88]: import joblib
```

```
In [89]: joblib.dump(rf,'model_joblib_heart1')
```

```
Out[89]: ['model_joblib_heart1']
```

```
In [90]: model = joblib.load('model_joblib_heart1')
```

```
In [92]: model.predict(test_df)
```

```
Out[92]: array([0], dtype=int64)
```

GUI - Graphical User Interface using Tkinter python library

```
In [93]: #import tkinter as tk
         from tkinter import *
         import joblib
```

```
In [94]: from PIL import ImageTk,Image
```

```
In [95]: def show_entry_fields():
             p1=int(e1.get())
             p2=int(e2.get())
             p3=int(e3.get())
             p4=int(e4.get())
             p5=int(e5.get())
             p6=int(e6.get())
             p7=int(e7.get())
             p8=int(e8.get())
             p9=int(e9.get())
             p10=float(e10.get())
             p11=int(e11.get())
             p12=int(e12.get())
             p13=int(e13.get())
             model = joblib.load('model_joblib_heart')
             result=model.predict([[p1,p2,p3,p4,p5,p6,p7,p8,p8,p10,p11,p12,p13]])

             if result == 0:
                 Label(master, text="No Heart Disease").grid(row=31)
             else:
                 Label(master, text="Possibility of Heart Disease").grid(row=31)


         master = Tk()
         master.title("Heart Disease Prediction System")
         #master.iconbitmap("doc.png")
         #master.geometry('800x400')

         master.configure(background = "#0096DC")

         #img1 = PhotoImage(name="img" , file ="doc.png")
         #label1 = Label(master , image = img1 , bd = 5 , relief = SUNKEN)
         #label1.pack(padx = 10 , pady = 10 )


         label = Label(master, text = "Heart Disease Prediction System" , bg = "black", fg = "white").grid(row=0,columnspan=5)


         Label(master, text="Enter Your Age").grid(row=1)
         Label(master, text="Male Or Female [1/0]").grid(row=2)
         Label(master, text="Enter Value of CP").grid(row=3)
         Label(master, text="Enter Value of trestbps").grid(row=4)
         Label(master, text="Enter Value of chol").grid(row=5)
         Label(master, text="Enter Value of fbs").grid(row=6)
         Label(master, text="Enter Value of restecg").grid(row=7)
         Label(master, text="Enter Value of thalach").grid(row=8)
         Label(master, text="Enter Value of exang").grid(row=9)
         Label(master, text="Enter Value of oldpeak").grid(row=10)
         Label(master, text="Enter Value of slope").grid(row=11)
         Label(master, text="Enter Value of ca").grid(row=12)
         Label(master, text="Enter Value of thal").grid(row=13)



         e1 = Entry(master)
         e2 = Entry(master)
         e3 = Entry(master)
         e4 = Entry(master)
         e5 = Entry(master)
         e6 = Entry(master)
         e7 = Entry(master)
         e8 = Entry(master)
         e9 = Entry(master)
         e10 = Entry(master)
         e11 = Entry(master)
         e12 = Entry(master)
         e13 = Entry(master)

         e1.grid(row=1, column=1)
         e2.grid(row=2, column=1)
         e3.grid(row=3, column=1)
         e4.grid(row=4, column=1)
         e5.grid(row=5, column=1)
         e6.grid(row=6, column=1)
         e7.grid(row=7, column=1)
         e8.grid(row=8, column=1)
         e9.grid(row=9, column=1)
         e10.grid(row=10, column=1)
         e11.grid(row=11, column=1)
         e12.grid(row=12, column=1)
         e13.grid(row=13, column=1)



         Button(master, text='Predict', command=show_entry_fields).grid()
```

```
mainloop()
```

The End

In [ ]: