IMPORTING LIBRARIES

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
```

READING DATASET

In [2]:
```
df=pd.read_csv(r"D:\Projects\Project\HEART DISEASE PREDICTION\heart.csv")
```

In [3]:
```
df
```

Out[3]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
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
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
298	57	0	0	140	241	0	1	123	1	0.2	1	0	3	0
299	45	1	3	110	264	0	1	132	0	1.2	1	0	3	0
300	68	1	0	144	193	1	1	141	0	3.4	1	2	3	0
301	57	1	0	130	131	0	1	115	1	1.2	1	1	3	0
302	57	0	1	130	236	0	0	174	0	0.0	1	1	2	0

303 rows × 14 columns

In [4]:
```
#getting the shape of the data
df.shape
```

Out[4]:
```
(303, 14)
```

In [6]:
```
#getting type of data for each column
df.dtypes
```

Out[6]:
```
age           int64
sex           int64
cp            int64
trestbps      int64
chol          int64
fbs           int64
restecg       int64
thalach       int64
exang         int64
oldpeak     float64
slope         int64
ca            int64
thal          int64
target        int64
dtype: object
```

In [7]:
```
df.head()
```

Out[7]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
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

DIVIDING DATA INTO DEPENDENT AND INDEPENDENT VARIABLE

In [9]:
```
#independent variable
x=df.drop("target",axis=1)
```

In [10]:
```
x
```

Out[10]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal
0	63	1	3	145	233	1	0	150	0	2.3	0	0	1
1	37	1	2	130	250	0	1	187	0	3.5	0	0	2
2	41	0	1	130	204	0	0	172	0	1.4	2	0	2
3	56	1	1	120	236	0	1	178	0	0.8	2	0	2
4	57	0	0	120	354	0	1	163	1	0.6	2	0	2
...	...	...	...	...	...	...	...	...	...	...	...	...	...
298	57	0	0	140	241	0	1	123	1	0.2	1	0	3
299	45	1	3	110	264	0	1	132	0	1.2	1	0	3
300	68	1	0	144	193	1	1	141	0	3.4	1	2	3
301	57	1	0	130	131	0	1	115	1	1.2	1	1	3
302	57	0	1	130	236	0	0	174	0	0.0	1	1	2

303 rows × 13 columns

In [11]:
```
#dependent variable(target variable)
y=df["target"]
```

In [12]:
```
y
```

Out[12]:
```
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
```

TRAIN TEST MODULE

In [13]:
```
#creating training data and test data for x and y variable
from sklearn.model_selection import train_test_split
```

In [14]:
```
xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.2,random_state=0)
```

In [15]:
```
xtrain
```

Out[15]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal
74	43	0	2	122	213	0	1	165	0	0.2	1	0	2
153	66	0	2	146	278	0	0	152	0	0.0	1	1	2
64	58	1	2	140	211	1	0	165	0	0.0	2	0	2
296	63	0	0	124	197	0	1	136	1	0.0	1	0	2
287	57	1	1	154	232	0	0	164	0	0.0	2	1	2
...	...	...	...	...	...	...	...	...	...	...	...	...	...
251	43	1	0	132	247	1	0	143	1	0.1	1	4	3
192	54	1	0	120	188	0	1	113	0	1.4	1	1	3
117	56	1	3	120	193	0	0	162	0	1.9	1	0	3

47	47	1	2	138	257	0	0	156	0	0.0	2	0	2
172	58	1	1	120	284	0	0	160	0	1.8	1	0	2

242 rows × 13 columns

In [16]:
```
ytrain
```

Out[16]:
```
74     1
153    1
64     1
296    0
287    0
      ..
251    0
192    0
117    1
47     1
172    0
Name: target, Length: 242, dtype: int64
```

In [17]:
```
xtest
```

Out[17]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal
225	70	1	0	145	174	0	1	125	1	2.6	0	0	3
152	64	1	3	170	227	0	0	155	0	0.6	1	0	3
228	59	1	3	170	288	0	0	159	0	0.2	1	0	3
201	60	1	0	125	258	0	0	141	1	2.8	1	1	3
52	62	1	2	130	231	0	1	146	0	1.8	1	3	3
...	...	...	...	...	...	...	...	...	...	...	...	...	...
146	44	0	2	118	242	0	1	149	0	0.3	1	1	2
302	57	0	1	130	236	0	0	174	0	0.0	1	1	2
26	59	1	2	150	212	1	1	157	0	1.6	2	0	2
108	50	0	1	120	244	0	1	162	0	1.1	2	0	2
89	58	0	0	100	248	0	0	122	0	1.0	1	0	2

61 rows × 13 columns

In [18]:
```
ytest
```

Out[18]:
```
225    0
152    1
228    0
201    0
52     1
      ..
146    1
302    0
26     1
108    1
89     1
Name: target, Length: 61, dtype: int64
```

FEATURE SCALING

In [19]:
```
#standardize the independent features present in the data in a fixed range.
from sklearn.preprocessing import StandardScaler
```

In [20]:
```
sc=StandardScaler()
```

In [23]:
```
xtrain=sc.fit_transform(xtrain)
xtest=sc.fit_transform(xtest)
```

In [24]:
```
xtrain
```

Out[24]:
```
array([[-1.32773282, -1.43641607,  0.98584243, ..., -0.66169316,
```

```
         -0.70710678, -0.46472917],
        [ 1.24903178, -1.43641607,  0.98584243, ..., -0.66169316,
          0.26516504, -0.46472917],
        [ 0.35276583,  0.69617712,  0.98584243, ...,  0.95577901,
         -0.70710678, -0.46472917],
        ...,
        [ 0.12869935,  0.69617712,  1.94013791, ..., -0.66169316,
         -0.70710678,  1.14190596],
        [-0.87959984,  0.69617712,  0.98584243, ...,  0.95577901,
         -0.70710678, -0.46472917],
        [ 0.35276583,  0.69617712,  0.03154696, ..., -0.66169316,
         -0.70710678, -0.46472917]])
```

In [25]:
```
xtest
```

Out[25]:
```
array([[ 1.87528580e+00,  6.21581561e-01, -1.01006076e+00,
          7.38067738e-01, -1.57231830e+00, -4.16025147e-01,
          8.91132789e-01, -1.09707537e+00,  1.54560308e+00,
          1.62748286e+00, -2.26232796e+00, -7.45049451e-01,
          1.06436231e+00],
        [ 1.23443183e+00,  6.21581561e-01,  2.12283957e+00,
          2.04685065e+00, -3.86846038e-01, -4.16025147e-01,
         -1.12216722e+00,  2.78025949e-01, -6.46996639e-01,
         -3.40335861e-01, -5.99653193e-01, -7.45049451e-01,
          1.06436231e+00],
        [ 7.00386852e-01,  6.21581561e-01,  2.12283957e+00,
          2.04685065e+00,  9.77565437e-01, -4.16025147e-01,
         -1.12216722e+00,  4.61372791e-01, -6.46996639e-01,
         -7.33899606e-01, -5.99653193e-01, -7.45049451e-01,
          1.06436231e+00],
        [ 8.07195847e-01,  6.21581561e-01, -1.01006076e+00,
         -3.08958588e-01,  3.06543400e-01, -4.16025147e-01,
         -1.12216722e+00, -3.63687998e-01,  1.54560308e+00,
          1.82426474e+00, -5.99653193e-01,  2.64906471e-01,
          1.06436231e+00],
        [ 1.02081384e+00,  6.21581561e-01,  1.07853946e+00,
         -4.72020065e-02, -2.97376433e-01, -4.16025147e-01,
          8.91132789e-01, -1.34504446e-01, -6.46996639e-01,
          8.40355374e-01, -5.99653193e-01,  2.28481832e+00,
          1.06436231e+00],
        [-4.74512092e-01,  6.21581561e-01, -1.01006076e+00,
         -3.61309905e-01,  6.64421820e-01, -4.16025147e-01,
         -1.12216722e+00,  7.82229765e-01, -6.46996639e-01,
         -4.38726798e-01, -5.99653193e-01, -7.45049451e-01,
          1.06436231e+00],
        [-1.32898405e+00,  6.21581561e-01, -1.01006076e+00,
         -1.09422833e+00, -1.72889011e+00, -4.16025147e-01,
         -1.12216722e+00, -1.60127918e+00,  1.54560308e+00,
          1.03713725e+00, -5.99653193e-01, -7.45049451e-01,
          1.06436231e+00],
        [ 1.12762283e+00,  6.21581561e-01, -1.01006076e+00,
         -4.72020065e-02,  2.17073795e-01, -4.16025147e-01,
         -1.12216722e+00, -8.86677351e-02, -6.46996639e-01,
          4.46791629e-01, -5.99653193e-01,  2.64906471e-01,
          1.06436231e+00],
        [ 3.79959867e-01, -1.60879933e+00, -1.01006076e+00,
          3.61739014e+00,  9.77565437e-01,  2.40370085e+00,
         -1.12216722e+00, -7.30381683e-01,  1.54560308e+00,
          3.00495597e+00, -2.26232796e+00,  1.27486239e+00,
          1.06436231e+00],
        [ 1.12762283e+00,  6.21581561e-01, -1.01006076e+00,
         -4.72020065e-02,  1.91699629e+00,  2.40370085e+00,
         -1.12216722e+00, -7.76218393e-01,  1.54560308e+00,
          8.40355374e-01,  1.06302157e+00,  2.28481832e+00,
          1.06436231e+00],
        [ 4.86768862e-01,  6.21581561e-01,  1.07853946e+00,
          9.99824320e-01, -2.64595356e+00,  2.40370085e+00,
          8.91132789e-01,  1.10308674e+00, -6.46996639e-01,
         -7.33899606e-01,  1.06302157e+00,  2.64906471e-01,
          1.06436231e+00],
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         -4.72020065e-02,  5.52584814e-01, -4.16025147e-01,
          8.91132789e-01,  6.44719633e-01, -6.46996639e-01,
         -9.30681479e-01,  1.06302157e+00, -7.45049451e-01,
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         -1.12216722e+00, -1.00540195e+00, -6.46996639e-01,
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          1.06436231e+00],
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```

```
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  8.91132789e-01,  2.06565766e+00, -6.46996639e-01,
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[ 1.02081384e+00,  6.21581561e-01,  3.42393479e-02,
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  8.91132789e-01,  1.40515818e-01, -6.46996639e-01,
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  8.91132789e-01,  4.15536081e-01, -6.46996639e-01,
 -1.43553989e-01,  1.06302157e+00,  2.64906471e-01,
```

```
 -7.39140495e-01],
[ 8.07195847e-01,  6.21581561e-01,  1.07853946e+00,
  4.76311157e-01, -1.32627689e+00, -4.16025147e-01,
 -1.12216722e+00,  2.78025949e-01, -6.46996639e-01,
  2.02104661e+00, -5.99653193e-01, -7.45049451e-01,
 -7.39140495e-01],
[-7.94939077e-01,  6.21581561e-01, -1.01006076e+00,
  5.81013789e-01,  1.44728086e+00, -4.16025147e-01,
 -1.12216722e+00, -8.86677351e-02,  1.54560308e+00,
 -9.30681479e-01, -5.99653193e-01,  2.28481832e+00,
  1.06436231e+00],
[-1.22217506e+00, -1.60879933e+00,  3.42393479e-02,
 -2.56607272e-01,  1.38017866e+00, -4.16025147e-01,
  8.91132789e-01,  6.44719633e-01, -6.46996639e-01,
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  8.91132789e-01,  5.98882923e-01, -6.46996639e-01,
 -4.38726798e-01,  1.06302157e+00, -7.45049451e-01,
  1.06436231e+00],
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```

IMPLEMENTING KNN ALGORITHM

In [53]:
```
#impprting algorithm
from sklearn.neighbors import KNeighborsClassifier
#creating no of neighbors (k=5)
```

```
classifier = KNeighborsClassifier(n_neighbors=12)
#train the model
classifier.fit(xtrain, ytrain)
```

Out[53]:
```
KNeighborsClassifier(n_neighbors=12)
```

MAKING PREDICTIONS

In [54]:
```
y_pred=classifier.predict(xtest)
y_pred
```

Out[54]:
```
array([0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 0,
       0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 0,
       1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1], dtype=int64)
```

CREATING DATA FRAME

In [55]:
```
#creating data frame for comparing actual values with predicted values
data=pd.DataFrame({"Actual":ytest,"Predicted":y_pred})
```

In [56]:
```
data
```

Out[56]:

	Actual	Predicted
225	0	0
152	1	1
228	0	0
201	0	0
52	1	0
...	...	...
146	1	1
302	0	1
26	1	1
108	1	1
89	1	1

61 rows × 2 columns

MAKING OWN PREDICTIONS

In [57]:
```
#making predictions for our own input values
y_pred2=classifier.predict([[63,1,3,145,233,1,0,150,0,23,0,0,1]])
```

In [58]:
```
#getting target vvalue for above mentioned inputs
y_pred2
```

Out[58]:
```
array([1], dtype=int64)
```

EVALUATING THE ALGORITHM

In [59]:
```
from sklearn.metrics import confusion_matrix,accuracy_score
```

In [60]:
```
#getting confusion matrix - since it is a classification problem
confusion_matrix(ytest,y_pred)
```

Out[60]:
```
array([[22,  5],
       [ 3, 31]], dtype=int64)
```

In [61]:
```
#getting accuracy of the model
accuracy_score(ytest,y_pred)
```

Out[61]: 0.8688524590163934

SELECTING K VALUE IN KNN

In [51]:
```
#calculating error rate with respect to the k value
error=[]
for i in range(1,40):
    knn=KNeighborsClassifier(n_neighbors=i)
    knn.fit(xtrain,ytrain)
    y_pred=knn.predict(xtest)
    error.append(np.mean(y_pred!=ytest))
print(error)
```

```
[0.18032786885245902, 0.21311475409836064, 0.16393442622950818, 0.14754098360655737, 0.16393442622950818, 0.14754
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```
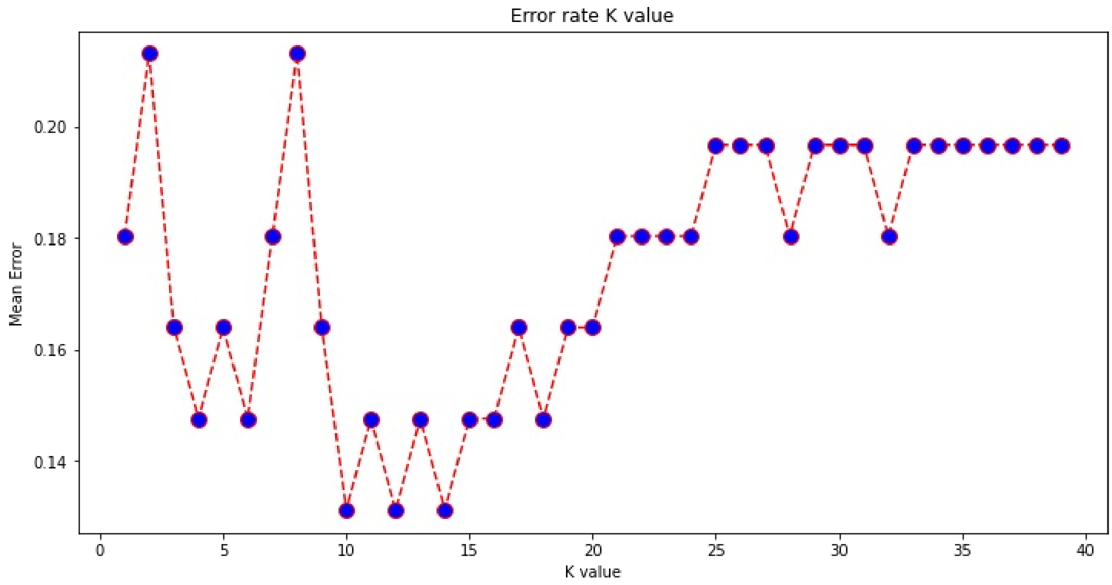

PLOTTING GRAPH BETWEEN K VALUE AND ERROR VALUE

In [52]:
```
plt.figure(figsize=(12,6))
plt.plot(range(1,40),error,color="red",linestyle="dashed",marker="o",markerfacecolor="blue",markersize=10)
plt.title("Error rate K value")
plt.xlabel("K value")
plt.ylabel("Mean Error")
```

Out[52]: Text(0, 0.5, 'Mean Error')



In [ ]:
```
#when the k value is 5 accuracy of the model is 83
#when the k values is 12 accuracy of the model is 86
#with the help of k value we can reduce the error and increase the accuracy.
```

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