PROJECT

June 13, 2023

$\#PROBLEM\ STATEMENT$:- TO PREDICT WHICH MODEL IS SUITABLE FOR THE GIVEN DATASET

IMPORTING THE ESSENTIAL LIBRARIES:-

```
[]: import numpy as np
import pandas as pd
from sklearn.linear_model import LinearRegression
```

LOADING THE DATASET:-

```
[]: df=pd.read_csv(r"/content/insurance.csv") df
```

[]:		age	sex	bmi	children	smoker	region	charges
	0	19	female	27.900	0	yes	southwest	16884.92400
	1	18	male	33.770	1	no	southeast	1725.55230
	2	28	male	33.000	3	no	southeast	4449.46200
	3	33	male	22.705	0	no	northwest	21984.47061
	4	32	male	28.880	0	no	northwest	3866.85520
				•••		•••	•••	
	1333	50	male	30.970	3	no	northwest	10600.54830
	1334	18	female	31.920	0	no	northeast	2205.98080
	1335	18	female	36.850	0	no	southeast	1629.83350
	1336	21	female	25.800	0	no	southwest	2007.94500
	1337	61	female	29.070	0	yes	northwest	29141.36030

[1338 rows x 7 columns]

TO PRINT THE FIRST 5 ROWS OF A DATASET:-

[]: df.head()

```
[]:
                            children smoker
       age
                        bmi
                                                 region
                                                             charges
                sex
        19 female 27.900
                                    0
                                             southwest
                                                        16884.92400
     0
                                         yes
        18
              male 33.770
                                    1
                                              southeast
                                                          1725.55230
     1
                                         no
              male 33.000
                                    3
     2
        28
                                              southeast
                                                          4449.46200
                                         no
     3
        33
              male 22.705
                                    0
                                             northwest 21984.47061
                                         no
              male 28.880
        32
                                    0
                                                          3866.85520
                                             northwest
                                         no
```

TO PRINT THE LAST 5 ROWS OF A DATASET:-

[]: df.tail()

```
[]:
                        bmi children smoker
                                                region
                                                           charges
          age
                  sex
                 male 30.97
                                    3
                                             northwest 10600.5483
    1333
           50
    1334
           18 female 31.92
                                    0
                                         no
                                             northeast
                                                         2205.9808
    1335
           18 female 36.85
                                    0
                                         no southeast
                                                         1629.8335
    1336
           21 female 25.80
                                    0
                                         no southwest
                                                         2007.9450
    1337
           61 female 29.07
                                    0
                                         yes northwest 29141.3603
```

TO KNOW THE BASIC INFORMATION OF A DATASET:-

[]: df.describe()

[]:		age	bmi	children	charges
	count	1338.000000	1338.000000	1338.000000	1338.000000
	mean	39.207025	30.663397	1.094918	13270.422265
	std	14.049960	6.098187	1.205493	12110.011237
	min	18.000000	15.960000	0.000000	1121.873900
	25%	27.000000	26.296250	0.000000	4740.287150
	50%	39.000000	30.400000	1.000000	9382.033000
	75%	51.000000	34.693750	2.000000	16639.912515
	max	64.000000	53.130000	5.000000	63770.428010

TO KNOW THE TYPE OF AN ATTRIBUTE:-

[]: df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 7 columns):

#	Column	Non-l	Null Count	Dtype
0	age	1338	non-null	int64
1	sex	1338	non-null	object
2	bmi	1338	non-null	float64
3	children	1338	non-null	int64
4	smoker	1338	non-null	object
5	region	1338	non-null	object
6	charges	1338	non-null	float64
dtyp	es: float6	4(2),	int64(2),	object(3)
memo	ry usage:	73.3+	KB	

TO KNOW THE SHAPE OF DATSET

[]: df.shape

[]: (1338, 7)

TO CHECK ANY NULL VALUE IS PRESENT OR NOT IN A DATASET:-

```
[]: df.isnull().any()
[]: age
                 False
                 False
     sex
     bmi
                False
                False
     children
     smoker
                False
    region
                False
     charges
                False
     dtype: bool
    SUBSET OF A DATASET
[]: df=df[['age','bmi','smoker','charges']]
[]:
                   bmi smoker
                                   charges
           age
               27.900
     0
            19
                          yes
                               16884.92400
     1
            18 33.770
                                1725.55230
                          no
     2
            28
               33.000
                                4449.46200
                          no
     3
            33 22.705
                               21984.47061
                          no
     4
            32 28.880
                                3866.85520
                          no
           50 30.970
     1333
                               10600.54830
                          no
                                2205.98080
     1334
            18 31.920
                          no
     1335
           18 36.850
                          no
                                1629.83350
     1336
            21 25.800
                                2007.94500
                          no
     1337
            61 29.070
                          yes 29141.36030
     [1338 rows x 4 columns]
    CONVERTING THE CATAGORICAL VALUE INTO INTEGER:-
[]: convert={"smoker":{"yes":1,"no":0}}
     df=df.replace(convert)
     df
[]:
          age
                   bmi
                        smoker
                                    charges
     0
            19
               27.900
                             1
                               16884.92400
               33.770
                                 1725.55230
     1
            18
                             0
     2
            28 33.000
                             0
                                 4449.46200
     3
            33 22.705
                               21984.47061
     4
            32 28.880
                                 3866.85520
                             0
     1333
            50 30.970
                             0 10600.54830
     1334
            18 31.920
                             0
                                 2205.98080
     1335
            18 36.850
                                 1629.83350
```

```
    1336
    21
    25.800
    0
    2007.94500

    1337
    61
    29.070
    1
    29141.36030
```

[1338 rows x 4 columns]

TO CHECK THE SHAPE OF THE SUBSETTED DATASET:-

```
[ ]: df.shape
```

[]: (1338, 4)

EXPLORATARY DATA ANALYSIS(EDA)

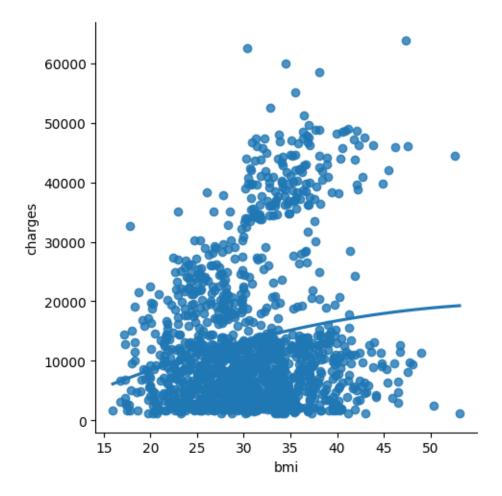
IMPORTING THE LIBRARIES FOR THE VISUVALIZATION

```
[]: import seaborn as sns import matplotlib.pyplot as plt
```

PLOTTING THE GRAPH:-

```
[]: sns.lmplot(x='bmi',y='charges',data=df,order=2,ci=None)
```

[]: <seaborn.axisgrid.FacetGrid at 0x7f98d28825c0>



TO RESHAPE THE DATA(TO MAKE DATA UNIFORM):-

```
[ ]: x=np.array(df['bmi']).reshape(-1,1)
y=np.array(df['charges']).reshape(-1,1)
```

IMPORTING LIBRARY TO SPLIT TRAINING SET AND TESTING SET

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

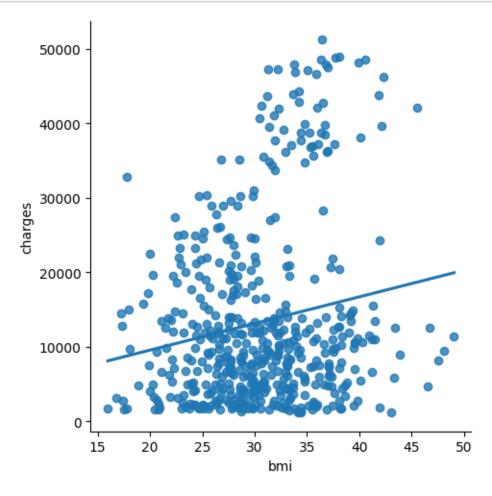
TO CHECK THE REGRESSION SCORE:-

```
[]: df.dropna(inplace=True)
    x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.25)
    regr=LinearRegression()
    regr.fit(x_train,y_train)
    print(regr.score(x_test,y_test))
```

0.025339979067911633

TO PLOT THE SUBSETTED DATASET:-

```
[]: df500=df[:][:500]
    sns.lmplot(x="bmi",y="charges",data=df500,order=1,ci=None)
    x=np.array(df500['bmi']).reshape(-1,1)
    y=np.array(df500['charges']).reshape(-1,1)
    df500.dropna(inplace=True)
    x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.25)
```

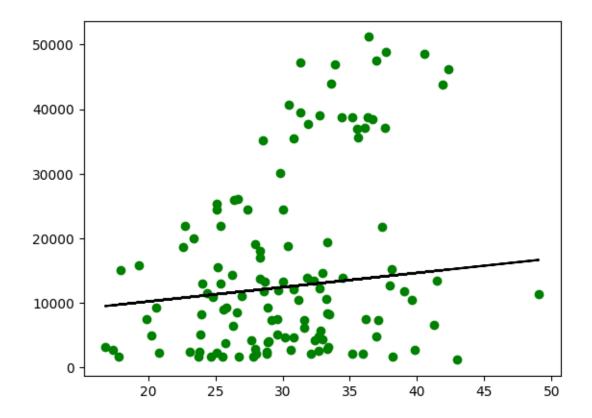


```
[]: regr=LinearRegression()
regr.fit(x_train,y_train)
print("Regression Score:",regr.score(x_test,y_test))
```

Regression Score: 0.004281638573397029

TO PLOT THE PREDICTED DATA:-

```
[]: y_pred=regr.predict(x_test)
plt.scatter(x_test,y_test,color='g')
plt.plot(x_test,y_pred,color='k')
plt.show()
```



#RIDGE MODEL:-

IMPORTING THE PACKAGES:-

```
[]: from sklearn.linear_model import Lasso,Ridge from sklearn.preprocessing import StandardScaler
```

DEFINING THE TARGET AND FEATURE VECTORS:-

```
[]: features= df.columns[0:3] target= df.columns[-1]
```

TO FIT THE TARGET AND FEATURE VECTORS:-

```
[]: x= df[features].values
    y= df[target].values
    x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3,random_state=0)
    scaler =StandardScaler()
    x_train=scaler.fit_transform(x_train)
    x_test=scaler.transform(x_test)
```

```
[]: ridgeReg=Ridge(alpha=10)
ridgeReg.fit(x_train,y_train)
train_score_ridge=ridgeReg.score(x_train,y_train)
```

```
test_score_ridge=ridgeReg.score(x_test,y_test)
```

SCORE OF THE RIDGE MODEL:-

```
[]: print("Ridge Model:-")
  print("the train score for ridge model is{}".format(train_score_ridge))
  print("the test score for ridge model is{}".format(test_score_ridge))
```

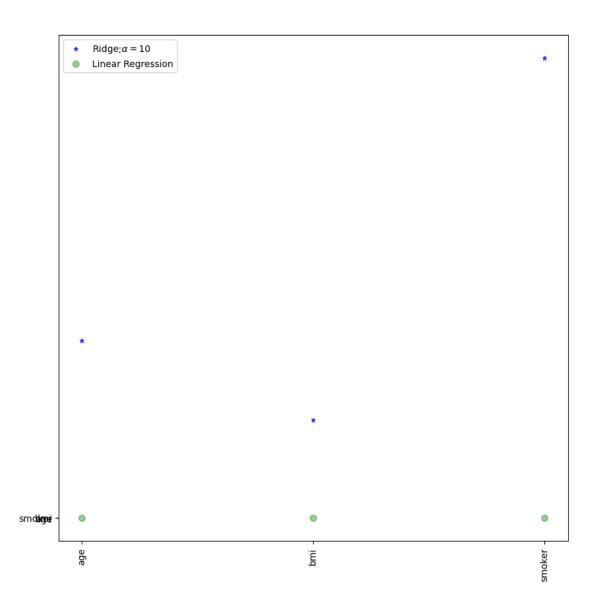
Ridge Model:-

the train score for ridge model is0.7277010627441683 the test score for ridge model is0.7865521942258982

ASSINGNING LINEAR REGRESSION TO LR:-

```
[]: lr=LinearRegression()
```

PLOTTING THE GRAPH:-



#LASSO MODEL:-

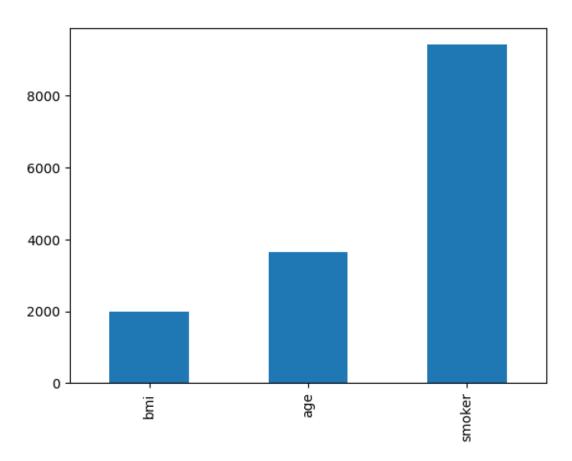
```
[]: print("Lasso Model:-")
    lasso=Lasso(alpha=10)
    lasso.fit(x_train,y_train)
    train_score_ls=lasso.score(x_train,y_train)
    test_score_ls=lasso.score(x_test,y_test)
    print("The train score for ls model is {}".format(train_score_ls))
    print("The test score for ls model is{}".format(test_score_ls))
```

Lasso Model:-

The train score for 1s model is 0.7277860363073241 The test score for 1s model is 0.7872229669132393

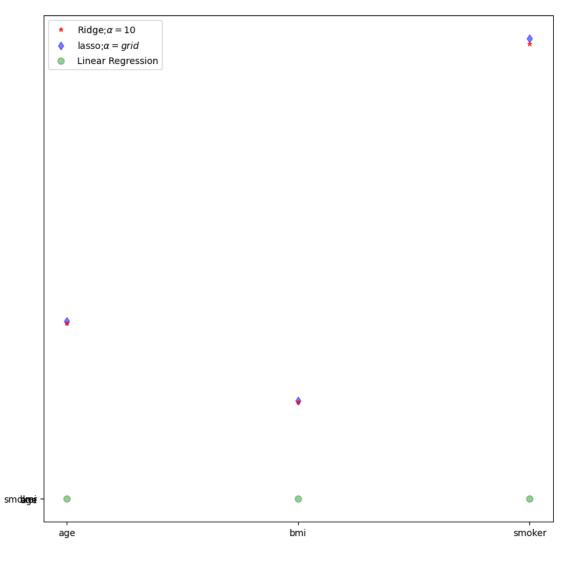
```
[]: pd.Series(lasso.coef_,features).sort_values(ascending=True).plot(kind="bar")
```

[]: <Axes: >



LASSO CV MODEL:-

- 0.7277881381968533
- 0.7872914671066007



#ELASTIC NET:-

```
[]: from sklearn.linear_model import ElasticNet regr=ElasticNet() regr.fit(x,y)
```

```
print(regr.coef_)
print(regr.intercept_)
print("The train score for ls model is {}".format(train_score_ls))
print("The test score for ls model is{}".format(test_score_ls))

[ 245.83491557   326.12836834  5849.22325507]
    -7566.060100878371
The train score for ls model is 0.7277860363073241
The test score for ls model is0.7872229669132393

[]: y_pred_elastic = regr.predict(x_train)
    mean_squared_error=np.mean((y_pred_elastic - y_train)**2)
```

497661202.9930098

CONCLUSION:-

THE LINEAR REGRESSION SCORE IS: -0.014637086277222489

THE RIDGE SCORE IS:-

print(mean_squared_error)

the train score for ridge model is: 0.7277010627441683 the test score for ridge model is: 0.7865521942258982

The Lasso Score IS:-

The train score for ls model is: 0. 727786036307324

The test score for ls model is:0.78 72229669132395

THE LASSO CV SCORE IS:-

The train score for lasso cv mode l is:0.7277881381968533

The test score for ls model is:0. 7872914671066007

THE ELASTIC NET SCORE IS:-

The train score for ls model is 0.727786036307324

The test score for ls model is 0. 7872229669132395

#LOGISTIC REGRESSION:-

IMPORTING THE ESSENTIAL LIBRARIES FOR LOGISTIC REGRESSION:-

```
[]: import numpy as np
import pandas as pd
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler
```

LOADING THE DATASET:-

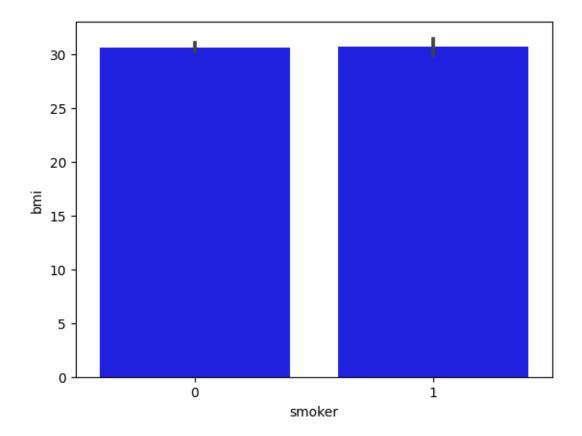
```
[]: df=pd.read_csv(r"/content/insurance.csv")
     df
[]:
                                   children smoker
                                                         region
            age
                     sex
                             bmi
                                                                      charges
     0
             19
                 female
                          27.900
                                           0
                                                ves
                                                      southwest
                                                                  16884.92400
     1
                          33.770
                                           1
             18
                   male
                                                      southeast
                                                                   1725.55230
                                                 no
     2
             28
                   male
                          33.000
                                           3
                                                      southeast
                                                                   4449.46200
                                                 no
     3
             33
                   male
                          22.705
                                           0
                                                      northwest
                                                                  21984.47061
                                                 no
     4
                                           0
             32
                          28.880
                                                      northwest
                                                                   3866.85520
                   male
                                                 no
     1333
                          30.970
                                           3
             50
                   male
                                                     northwest
                                                                  10600.54830
                                                 no
                                           0
     1334
             18
                 female
                          31.920
                                                 no
                                                      northeast
                                                                   2205.98080
                 female
                          36.850
                                           0
     1335
             18
                                                 no
                                                      southeast
                                                                   1629.83350
     1336
             21
                 female
                          25.800
                                           0
                                                      southwest
                                                                   2007.94500
                                                 no
     1337
                 female
                          29.070
                                           0
                                                yes
                                                     northwest
                                                                  29141.36030
     [1338 rows x 7 columns]
[]: pd.set_option('display.max_rows',10000000000)
     pd.set option('display.max columns',10000000000)
     pd.set_option('display.width',95)
    df.shape
[]:
[]: (1338, 7)
[]: convert={"sex":{"male":1,"female":0}}
     df=df.replace(convert)
     df
Г1:
                          bmi
                                children smoker
                                                      region
                                                                    charges
            age
                 sex
                       27.900
     0
             19
                   0
                                       0
                                                  southwest
                                                               16884.924000
                                             yes
                       33.770
     1
             18
                   1
                                       1
                                                  southeast
                                                                1725.552300
                                              no
     2
             28
                   1
                       33.000
                                       3
                                                  southeast
                                                                4449.462000
                                              no
     3
             33
                   1
                       22.705
                                       0
                                                  northwest
                                                               21984.470610
                                              no
     4
             32
                       28.880
                                       0
                   1
                                              no
                                                  northwest
                                                                3866.855200
     5
                                       0
             31
                   0
                       25.740
                                                  southeast
                                                                3756.621600
                                              no
     6
             46
                   0
                       33.440
                                       1
                                                  southeast
                                                                8240.589600
                                              no
     7
             37
                   0
                       27.740
                                       3
                                                  northwest
                                                                7281.505600
                                              nο
     8
                       29.830
                                       2
             37
                   1
                                                  northeast
                                                                6406.410700
                                              nο
                                       0
     9
             60
                   0
                       25.840
                                                  northwest
                                                              28923.136920
                                              no
     10
             25
                       26.220
                                       0
                   1
                                                  northeast
                                                                2721.320800
                                              no
     11
             62
                   0
                       26.290
                                       0
                                                  southeast
                                                              27808.725100
                                             yes
                                       0
     12
             23
                   1
                       34.400
                                                  southwest
                                                                1826.843000
                                              no
     13
                       39.820
                                       0
             56
                                                  southeast
                                                               11090.717800
                                              no
                                       0
     14
             27
                   1
                       42.130
                                                  southeast
                                                               39611.757700
                                             yes
     15
             19
                       24,600
                                       1
                                                  southwest
                                                                1837.237000
                                              no
```

```
1304
       42
              1 24.605
                                  2
                                              northeast
                                                          21259.377950
                                  0
       24
                 27.720
                                           0
1305
                                              southeast
                                                            2464.618800
1306
       29
                 21.850
                                  0
                                              northeast
                                                          16115.304500
1307
       32
                 28.120
                                  4
                                              northwest
                                                          21472.478800
              1
                 30.200
                                  0
1308
       25
                                           1
                                              southwest
                                                          33900.653000
1309
                 32.200
                                  2
                                           0
                                              southwest
       41
              1
                                                           6875.961000
1310
       42
              1
                 26.315
                                  1
                                           0
                                              northwest
                                                           6940.909850
1311
       33
              0
                 26.695
                                  0
                                           0
                                              northwest
                                                           4571.413050
                                  1
1312
                 42.900
                                           0
                                              southwest
                                                           4536.259000
       34
              1
                                  2
1313
       19
                 34.700
                                              southwest
                                                          36397.576000
                 23.655
                                  3
1314
       30
              0
                                              northwest
                                                          18765.875450
1315
                 28.310
                                  1
                                              northeast
       18
              1
                                                          11272.331390
1316
       19
              0
                 20.600
                                  0
                                           0
                                              southwest
                                                           1731.677000
                 53.130
                                              southeast
1317
       18
              1
                                  0
                                           0
                                                           1163.462700
                                  4
1318
                 39.710
                                           0
                                              northeast
       35
              1
                                                          19496.719170
1319
       39
                 26.315
                                  2
                                           0
                                              northwest
                                                           7201.700850
                                  3
                 31.065
                                           0
                                              northwest
1320
       31
              1
                                                           5425.023350
                 26.695
                                  0
1321
       62
                                              northeast
                                                          28101.333050
                                  0
1322
       62
                 38.830
                                              southeast
                                                          12981.345700
              1
1323
                 40.370
                                  2
       42
              0
                                           1
                                              southeast
                                                          43896.376300
1324
       31
              1
                 25.935
                                  1
                                           0
                                              northwest
                                                           4239.892650
                                  0
                                           0
1325
       61
              1
                 33.535
                                              northeast
                                                          13143.336650
1326
       42
                 32.870
                                  0
                                           0
              0
                                              northeast
                                                           7050.021300
1327
       51
              1
                 30.030
                                  1
                                           0
                                              southeast
                                                           9377.904700
                 24.225
                                  2
                                           0
                                              northeast
1328
       23
              0
                                                          22395.744240
1329
       52
                 38.600
                                  2
                                              southwest
                                                          10325.206000
1330
       57
                 25.740
                                  2
                                              southeast
                                                          12629.165600
                                  0
1331
       23
              0
                 33.400
                                           0
                                              southwest
                                                          10795.937330
1332
       52
              0
                 44.700
                                  3
                                           0
                                              southwest
                                                          11411.685000
1333
              1 30.970
                                  3
                                           0
                                              northwest
                                                          10600.548300
       50
                                  0
                                           0
1334
       18
              0
                 31.920
                                              northeast
                                                           2205.980800
              0
                 36.850
                                  0
                                           0
                                              southeast
1335
       18
                                                           1629.833500
                                  0
1336
       21
                 25.800
                                              southwest
                                                            2007.945000
1337
       61
                 29.070
                                  0
                                              northwest
                                                          29141.360300
```

```
[]: features_matrix=df.iloc[:,0:4] target_vector=df.iloc[:,-3]
```

The Feature Matrix has 1338 Rows and 4 columns(s)
The Target Matrix has 1338 Rows and 1 columns(s)

```
[]: import matplotlib.pyplot as plt
import seaborn as sns
[]: sns.barplot(x='smoker',y='bmi',data=df,color='b')
[]: <Axes: xlabel='smoker', ylabel='bmi'>
```



The model predicted the observation to belong to class [0]

print('The model predicted the observation to belong to class %s'%(predictions))

```
[]: print('The algoritham was trained to predict one of the two classes:
      →%s'%(algorithm.classes_))
    The algorithmm was trained to predict one of the two classes:[0 1]
[]: print(" " "The Model says the probability of the observation we passed...
      ⇔belonging to class['b'] Is %s" " "%(algorithm.
      →predict_proba(observation)[0][0]))
    print()
     The Model says the probability of the observation we passed belonging to
    class['b'] Is 0.8057078436306042
[]: print(" " "The Model says the probability of the observation we passed,
      ⇒belonging to class['g'] Is %s " " "%(algorithm.
      →predict_proba(observation)[0][1]))
     The Model says the probability of the observation we passed belonging to
    class['g'] Is 0.19429215636939584
[]: x=np.array(df['bmi']).reshape(-1,1)
    y=np.array(df['smoker']).reshape(-1,1)
[]: log=LogisticRegression()
    log.fit(x,y)
    print("Logistic Regression Score:",log.score(x,y))
    Logistic Regression Score: 0.7952167414050823
    /usr/local/lib/python3.10/dist-packages/sklearn/utils/validation.py:1143:
    DataConversionWarning: A column-vector y was passed when a 1d array was
    expected. Please change the shape of y to (n_samples, ), for example using
    ravel().
      y = column_or_1d(y, warn=True)
    CONCLUSION:-
    THE SCORE OF LOGISTIC REGRESSION IS: 0.7952167414050823
    #DESICION TREE:-
[]: import numpy as np
    import pandas as pd
    import seaborn as sns
    from sklearn.model_selection import train_test_split
    from sklearn.tree import DecisionTreeClassifier
[]: df=pd.read_csv(r"/content/insurance.csv")
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29 31 male 36.300 2 yes southwest 38711.000000 30 22 male 35.600 0 yes southwest 35585.576000 31 18 female 26.315 0 no northeast 2198.189850 32 19 female 28.600 5 no southwest 4687.797000 33 63 male 28.310 0 no northwest 13770.097900 34 28 male 36.400 1 yes southwest 51194.559140 35 19 male 20.425 0 no northwest 1625.433750 36 62 female 32.965 3 no northwest 15612.193350 37 26 male 20.800 0 no southwest 2302.300000 38 35 male 36.670 1 yes northeast 39774.276300 40 24 female 26.600 0 no northeast 3046.062000								
30								
31						•		
32 19 female 28.600 5 no southwest 4687.797000 33 63 male 28.310 0 no northwest 13770.097900 34 28 male 36.400 1 yes southwest 51194.559140 35 19 male 20.425 0 no northwest 1625.433750 36 62 female 32.965 3 no northwest 15612.193350 37 26 male 20.800 0 no southwest 2302.300000 38 35 male 36.670 1 yes northeast 39774.276300 39 60 male 39.900 0 yes southwest 48173.361000 40 24 female 26.600 0 no northeast 3046.062000 41 31 female 36.630 2 no southeast 4949.758700 42 41 male 21.780 1 no southeast 6272.477200 43 37 female 30.800 2 no southeast 6313.759000 44 38 male 37.050 1 no northeast 6079.671500 <td></td> <td></td> <td></td> <td></td> <td></td> <td>yes</td> <td></td> <td></td>						yes		
33 63 male 28.310 0 no northwest 13770.097900 34 28 male 36.400 1 yes southwest 51194.559140 35 19 male 20.425 0 no northwest 1625.433750 36 62 female 32.965 3 no northwest 15612.193350 37 26 male 20.800 0 no southwest 2302.300000 38 35 male 36.670 1 yes northeast 39774.276300 39 60 male 39.900 0 yes southwest 48173.361000 40 24 female 26.600 0 no northeast 3046.062000 41 31 female 36.630 2 no southeast 4949.758700 42 41 male 21.780 1 no southeast 6272.477200 43 37 female 30.800 2 no southeast 6313.759000 44 38 male 37.050 1 no northeast 6079.671500								
34 28 male 36.400 1 yes southwest 51194.559140 35 19 male 20.425 0 no northwest 1625.433750 36 62 female 32.965 3 no northwest 15612.193350 37 26 male 20.800 0 no southwest 2302.300000 38 35 male 36.670 1 yes northeast 39774.276300 39 60 male 39.900 0 yes southwest 48173.361000 40 24 female 26.600 0 no northeast 3046.062000 41 31 female 36.630 2 no southeast 4949.758700 42 41 male 21.780 1 no southeast 6272.477200 43 37 female 30.800 2 no southeast 6313.759000 44 38 male 37.050 1 no northeast 6079.671500 <								
35								
36 62 female 32.965 3 no northwest 15612.193350 37 26 male 20.800 0 no southwest 2302.300000 38 35 male 36.670 1 yes northeast 39774.276300 39 60 male 39.900 0 yes southwest 48173.361000 40 24 female 26.600 0 no northeast 3046.062000 41 31 female 36.630 2 no southeast 4949.758700 42 41 male 21.780 1 no southeast 6272.477200 43 37 female 30.800 2 no southeast 6313.759000 44 38 male 37.050 1 no northeast 6079.671500						•		
37 26 male 20.800 0 no southwest 2302.300000 38 35 male 36.670 1 yes northeast 39774.276300 39 60 male 39.900 0 yes southwest 48173.361000 40 24 female 26.600 0 no northeast 3046.062000 41 31 female 36.630 2 no southeast 4949.758700 42 41 male 21.780 1 no southeast 6272.477200 43 37 female 30.800 2 no southeast 6313.759000 44 38 male 37.050 1 no northeast 6079.671500								
38								
39 60 male 39.900 0 yes southwest 48173.361000 40 24 female 26.600 0 no northeast 3046.062000 41 31 female 36.630 2 no southeast 4949.758700 42 41 male 21.780 1 no southeast 6272.477200 43 37 female 30.800 2 no southeast 6313.759000 44 38 male 37.050 1 no northeast 6079.671500								
40 24 female 26.600 0 no northeast 3046.062000 41 31 female 36.630 2 no southeast 4949.758700 42 41 male 21.780 1 no southeast 6272.477200 43 37 female 30.800 2 no southeast 6313.759000 44 38 male 37.050 1 no northeast 6079.671500						•		
41 31 female 36.630 2 no southeast 4949.758700 42 41 male 21.780 1 no southeast 6272.477200 43 37 female 30.800 2 no southeast 6313.759000 44 38 male 37.050 1 no northeast 6079.671500						•		
42 41 male 21.780 1 no southeast 6272.477200 43 37 female 30.800 2 no southeast 6313.759000 44 38 male 37.050 1 no northeast 6079.671500								
43 37 female 30.800 2 no southeast 6313.759000 44 38 male 37.050 1 no northeast 6079.671500								
44 38 male 37.050 1 no northeast 6079.671500								
45 55 male 37.300 0 no southwest 20630.283510								
	45	55	male	37.300	0	no	southwest	20630.283510

```
1315
        18
                     28.310
                                      1
                                                              11272.331390
              male
                                             no
                                                 northeast
                                      0
1316
        19
                     20.600
                                                               1731.677000
            female
                                                 southwest
                                             no
1317
        18
              male
                     53.130
                                      0
                                             no
                                                 southeast
                                                               1163.462700
1318
        35
                     39.710
                                      4
                                                              19496.719170
              male
                                                 northeast
                                             no
                                      2
1319
        39
            female
                     26.315
                                                 northwest
                                                               7201.700850
                                             no
1320
                     31.065
                                      3
                                                               5425.023350
        31
              male
                                                 northwest
                                             no
                                      0
1321
       62
                     26.695
                                                              28101.333050
              male
                                            yes
                                                 northeast
                                      0
1322
        62
              male
                     38.830
                                                 southeast
                                                              12981.345700
                                             no
                                      2
1323
        42
            female
                     40.370
                                                              43896.376300
                                            yes
                                                 southeast
                                      1
1324
        31
              male
                     25.935
                                                 northwest
                                                               4239.892650
                                             no
                                      0
1325
        61
              male
                     33.535
                                             no
                                                 northeast
                                                              13143.336650
1326
            female
                     32.870
                                      0
                                                               7050.021300
        42
                                                 northeast
                                             nο
1327
       51
              male
                     30.030
                                      1
                                                 southeast
                                                               9377.904700
                                             nο
1328
        23
            female
                     24.225
                                      2
                                                              22395.744240
                                             no
                                                 northeast
                                      2
1329
        52
                     38.600
                                                              10325.206000
              male
                                                 southwest
                                             no
                                      2
1330
        57
            female
                     25.740
                                                 southeast
                                                              12629.165600
                                             no
                                      0
        23
1331
            female
                     33.400
                                                 southwest
                                                              10795.937330
                                             no
                     44.700
                                      3
1332
        52
            female
                                             no
                                                 southwest
                                                              11411.685000
                                      3
1333
        50
                     30.970
                                                 northwest
                                                              10600.548300
              male
                                             no
1334
                     31.920
                                      0
        18
            female
                                                 northeast
                                                               2205.980800
                                             nο
                                      0
1335
        18
            female
                     36.850
                                                 southeast
                                                               1629.833500
                                             no
                                      0
1336
        21
            female
                     25.800
                                                               2007.945000
                                             no
                                                 southwest
                     29.070
                                      0
1337
        61
            female
                                                              29141.360300
                                            yes
                                                 northwest
```

```
[]: convert={"sex":{"male":1,"female":0}}
   df=df.replace(convert)
   df
```

```
[]:
                                 children smoker
            age
                  sex
                           bmi
                                                        region
                                                                       charges
                        27.900
     0
             19
                    0
                                         0
                                                     southwest
                                                                 16884.924000
                                               yes
     1
             18
                    1
                        33.770
                                         1
                                                                  1725.552300
                                                no
                                                     southeast
     2
             28
                    1
                        33.000
                                         3
                                                     southeast
                                                                  4449.462000
                                                no
     3
                                         0
             33
                    1
                        22.705
                                                     northwest
                                                                 21984.470610
                                                nο
     4
                        28.880
                                         0
             32
                    1
                                                no
                                                     northwest
                                                                  3866.855200
     5
                                         0
             31
                    0
                        25.740
                                                     southeast
                                                                  3756.621600
                                                no
     6
             46
                    0
                        33.440
                                         1
                                                     southeast
                                                                  8240.589600
                                                nο
     7
                        27.740
                                         3
             37
                    0
                                                    northwest
                                                                  7281.505600
                                                no
     8
             37
                    1
                        29.830
                                         2
                                                     northeast
                                                                  6406.410700
                                                no
     9
                                         0
             60
                    0
                        25.840
                                                     northwest
                                                                 28923.136920
                                                no
     10
             25
                    1
                        26.220
                                         0
                                                                  2721.320800
                                                     northeast
                                                no
     11
             62
                        26.290
                                         0
                    0
                                                     southeast
                                                                 27808.725100
                                               yes
                                         0
     12
             23
                    1
                        34.400
                                                no
                                                     southwest
                                                                  1826.843000
                                         0
     13
             56
                        39.820
                                                                 11090.717800
                                                     southeast
                                                no
     14
             27
                    1
                        42.130
                                         0
                                                     southeast
                                                                 39611.757700
                                               yes
     15
             19
                    1
                        24.600
                                         1
                                                     southwest
                                                                  1837.237000
                                                no
             52
     16
                    0
                        30.780
                                         1
                                                                 10797.336200
                                                nο
                                                     northeast
                                         0
     17
             23
                        23.845
                                                no
                                                     northeast
                                                                  2395.171550
```

```
1334
                 0 31.920
                                                         2205.980800
           18
                                   0
                                         no northeast
                 0 36.850
     1335
           18
                                   0
                                             southeast
                                                         1629.833500
                                         no
     1336
           21
                 0 25.800
                                   0
                                                         2007.945000
                                             southwest
                                         no
     1337
           61
                 0 29.070
                                             northwest 29141.360300
                                        yes
[]: convert={'smoker':{"yes":1,"no":0}}
    df=df.replace(convert)
     df
```

[]:	age	sex	bmi	children	smoker	region	charges
0	19	0	27.900	0	1	southwest	16884.924000
1	18	1	33.770	1	0	southeast	1725.552300
2	28	1	33.000	3	0	southeast	4449.462000
3	33	1	22.705	0	0	northwest	21984.470610
4	32	1	28.880	0	0	northwest	3866.855200
5	31	0	25.740	0	0	southeast	3756.621600
6	46	0	33.440	1	0	southeast	8240.589600
7	37	0	27.740	3	0	northwest	7281.505600
8	37	1	29.830	2	0	northeast	6406.410700
9	60	0	25.840	0	0	northwest	28923.136920
10	25	1	26.220	0	0	northeast	2721.320800
11	62	0	26.290	0	1	southeast	27808.725100
12	23	1	34.400	0	0	southwest	1826.843000
13	56	0	39.820	0	0	southeast	11090.717800
14	27	1	42.130	0	1	southeast	39611.757700
15	19	1	24.600	1	0	southwest	1837.237000
16	52	0	30.780	1	0	northeast	10797.336200
17	23	1	23.845	0	0	northeast	2395.171550
18	56	1	40.300	0	0	southwest	10602.385000
19	30	1	35.300	0	1	southwest	36837.467000
20	60	0	36.005	0	0	northeast	13228.846950
21	30	0	32.400	1	0	southwest	4149.736000
22	18	1	34.100	0	0	southeast	1137.011000
23	34	0	31.920	1	1	northeast	37701.876800
24	37	1	28.025	2	0	northwest	6203.901750
25	59	0	27.720	3	0	southeast	14001.133800
26	63	0	23.085	0	0	northeast	14451.835150
27	55	0	32.775	2	0	northwest	12268.632250
28	23	1	17.385	1	0	northwest	2775.192150
29	31	1	36.300	2	1	southwest	38711.000000
30	22	1	35.600	0	1	southwest	35585.576000
31	18	0	26.315	0	0	northeast	2198.189850
32	19	0	28.600	5	0	southwest	4687.797000
33	63	1	28.310	0	0	northwest	13770.097900
34	28	1	36.400	1	1	southwest	51194.559140
35	19	1	20.425	0	0	northwest	1625.433750
36	62	0	32.965	3	0	northwest	15612.193350

```
1307
             32
                      28.120
                                      4
                                               1
                                                              21472.478800
                                                  northwest
     1308
             25
                      30.200
                                      0
                                                  southwest
                                                              33900.653000
                                      2
     1309
            41
                   1
                      32.200
                                               0
                                                  southwest
                                                               6875.961000
             42
                                      1
     1310
                   1
                      26.315
                                               0
                                                  northwest
                                                               6940.909850
     1311
             33
                      26.695
                                      0
                                               0
                                                  northwest
                   0
                                                               4571.413050
                      42.900
                                               0
     1312
             34
                   1
                                      1
                                                  southwest
                                                               4536.259000
                                      2
     1313
             19
                   0
                      34.700
                                               1
                                                  southwest
                                                              36397.576000
     1314
                      23.655
                                      3
                                               1
                                                  northwest
                                                              18765.875450
             30
                   0
                                      1
     1315
             18
                      28.310
                                                  northeast
                                                              11272.331390
     1316
             19
                   0
                      20.600
                                      0
                                               0
                                                  southwest
                                                               1731.677000
     1317
                      53.130
                                      0
                                                  southeast
                                                               1163.462700
             18
                   1
     1318
             35
                   1
                      39.710
                                      4
                                               0
                                                  northeast
                                                             19496.719170
     1319
             39
                   0
                      26.315
                                      2
                                               0
                                                  northwest
                                                               7201.700850
                                      3
     1320
                      31.065
                                               0
                                                  northwest
                                                               5425.023350
             31
                   1
     1321
             62
                      26.695
                                      0
                                               1
                                                  northeast
                                                              28101.333050
                                      0
                      38.830
                                               0
     1322
             62
                   1
                                                  southeast
                                                              12981.345700
                     40.370
                                      2
                                               1
     1323
             42
                   0
                                                  southeast
                                                              43896.376300
     1324
             31
                      25.935
                                      1
                                                  northwest
                                                               4239.892650
                   1
     1325
                                      0
                                               0
             61
                   1
                      33.535
                                                  northeast
                                                              13143.336650
                                      0
     1326
             42
                   0
                      32.870
                                               0
                                                  northeast
                                                               7050.021300
                                      1
                                               0
     1327
             51
                   1
                      30.030
                                                  southeast
                                                               9377.904700
     1328
             23
                      24.225
                                      2
                                               0
                                                              22395.744240
                   0
                                                  northeast
                                      2
     1329
             52
                   1
                      38,600
                                               0
                                                  southwest
                                                              10325.206000
     1330
                      25.740
                                      2
                                               0
             57
                   0
                                                  southeast
                                                              12629.165600
     1331
             23
                      33.400
                                      0
                                                  southwest
                                                              10795.937330
     1332
             52
                   0
                      44.700
                                      3
                                                  southwest
                                                              11411.685000
                      30.970
                                      3
     1333
            50
                   1
                                               0
                                                  northwest
                                                              10600.548300
     1334
             18
                   0
                      31.920
                                      0
                                               0
                                                  northeast
                                                               2205.980800
                                      0
     1335
                      36.850
                                               0
                                                  southeast
                                                               1629.833500
             18
                   0
                                      0
     1336
             21
                   0
                      25.800
                                                  southwest
                                                               2007.945000
                                      0
     1337
                      29.070
                                                              29141.360300
             61
                                                  northwest
[]: x=["children", "age"]
     y=["0","1"]
     all_inputs=df[x]
     all_classes=df["smoker"]
     (x_train,x_test,y_train,y_test)=train_test_split(all_inputs,all_classes,test_size=0.
      ⇔03)
[]: clf=DecisionTreeClassifier(random state=0)
[]: clf.fit(x_train,y_train)
[ ]: DecisionTreeClassifier(random_state=0)
```

1306

29

0

21.850

0

northeast

16115.304500

```
[]: score=clf.score(x_test,y_test)
print(score)
```

0.7804878048780488

CONCLUSION:-

THE SCORE OF THE DECISION TREE IS: 1.0

1 RANDOM FOREST:-

```
[]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

```
[ ]: df=pd.read_csv(r"/content/insurance.csv")
df
```

[]:	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	yes	southwest	16884.924000
1	18	male	33.770	1	no	southeast	1725.552300
2	28	male	33.000	3	no	southeast	4449.462000
3	33	male	22.705	0	no	northwest	21984.470610
4	32	male	28.880	0	no	northwest	3866.855200
5	31	female	25.740	0	no	southeast	3756.621600
6	46	female	33.440	1	no	southeast	8240.589600
7	37	female	27.740	3	no	northwest	7281.505600
8	37	male	29.830	2	no	northeast	6406.410700
9	60	female	25.840	0	no	northwest	28923.136920
10	25	male	26.220	0	no	northeast	2721.320800
11	62	female	26.290	0	yes	southeast	27808.725100
12	23	male	34.400	0	no	southwest	1826.843000
13	56	female	39.820	0	no	southeast	11090.717800
14	27	male	42.130	0	yes	southeast	39611.757700
15	19	male	24.600	1	no	southwest	1837.237000
16	52	female	30.780	1	no	northeast	10797.336200
17	23	male	23.845	0	no	northeast	2395.171550
18	56	male	40.300	0	no	southwest	10602.385000
19	30	male	35.300	0	yes	southwest	36837.467000
20	60	female	36.005	0	no	northeast	13228.846950
21	30	female	32.400	1	no	southwest	4149.736000
22	18	male	34.100	0	no	southeast	1137.011000
23	34	female	31.920	1	yes	northeast	37701.876800
24	37	male	28.025	2	no	northwest	6203.901750
25	59	female	27.720	3	no	southeast	14001.133800
26	63	female	23.085	0	no	northeast	14451.835150
27	55	female	32.775	2	no	northwest	12268.632250

```
1297
        28
                     26.510
                                      2
                                                               4340.440900
            female
                                             no
                                                 southeast
                                      2
        33
                     27.455
1298
              male
                                                 northwest
                                                               5261.469450
                                             no
1299
        19
            female
                     25.745
                                      1
                                             no
                                                 northwest
                                                               2710.828550
1300
       45
                     30.360
                                      0
                                            yes
              male
                                                 southeast
                                                              62592.873090
                                      3
1301
        62
              male
                     30.875
                                                 northwest
                                                              46718.163250
                                            yes
1302
        25
                                      1
            female
                     20.800
                                             no
                                                 southwest
                                                               3208.787000
                                      0
1303
        43
                     27.800
                                                              37829.724200
              male
                                            yes
                                                 southwest
                                      2
1304
        42
              male
                     24.605
                                                 northeast
                                                              21259.377950
                                            yes
        24
            female
                     27.720
                                      0
1305
                                             no
                                                 southeast
                                                               2464.618800
1306
        29
            female
                     21.850
                                      0
                                                 northeast
                                                              16115.304500
                                            yes
1307
        32
              male
                     28.120
                                      4
                                            yes
                                                 northwest
                                                              21472.478800
                     30.200
                                      0
1308
        25
            female
                                                 southwest
                                                              33900.653000
                                            yes
1309
        41
              male
                     32.200
                                      2
                                                 southwest
                                                               6875.961000
                                             no
1310
        42
                     26.315
                                      1
                                                               6940.909850
              male
                                             no
                                                 northwest
                                      0
                     26.695
1311
        33
            female
                                                 northwest
                                                               4571.413050
                                             no
1312
        34
              male
                     42.900
                                      1
                                                 southwest
                                                               4536.259000
                                             no
                                      2
1313
        19
            female
                     34.700
                                                 southwest
                                                              36397.576000
                                            yes
                                      3
1314
        30
            female
                     23.655
                                            yes
                                                 northwest
                                                              18765.875450
1315
                     28.310
                                      1
                                                              11272.331390
        18
              male
                                             no
                                                 northeast
                                      0
1316
        19
            female
                     20.600
                                                 southwest
                                                               1731.677000
                                             no
1317
        18
              male
                     53.130
                                      0
                                                 southeast
                                                               1163.462700
                                             no
1318
                                      4
        35
                     39.710
                                                              19496.719170
              male
                                             no
                                                 northeast
                                      2
1319
        39
            female
                     26.315
                                                               7201.700850
                                             no
                                                 northwest
                                                               5425.023350
1320
        31
              male
                     31.065
                                      3
                                                 northwest
                                             no
                                      0
1321
        62
              male
                     26.695
                                                 northeast
                                                              28101.333050
                                            yes
1322
        62
              male
                     38.830
                                      0
                                                 southeast
                                                              12981.345700
                                             no
1323
        42
            female
                     40.370
                                      2
                                                 southeast
                                                              43896.376300
                                            yes
1324
        31
              male
                     25.935
                                      1
                                                 northwest
                                                               4239.892650
                                             no
1325
        61
              male
                     33.535
                                      0
                                                 northeast
                                                              13143.336650
                                             no
                                      0
1326
                     32.870
                                                               7050.021300
       42
            female
                                                 northeast
                                             no
                                      1
1327
        51
              male
                     30.030
                                             no
                                                 southeast
                                                               9377.904700
                                      2
        23
                     24.225
                                                              22395.744240
1328
            female
                                             no
                                                 northeast
                                      2
1329
        52
              male
                     38.600
                                                 southwest
                                                              10325.206000
                                             no
                                      2
1330
        57
            female
                     25.740
                                                 southeast
                                                              12629.165600
                                             no
                                      0
1331
        23
            female
                     33.400
                                                 southwest
                                                              10795.937330
                                             no
1332
        52
            female
                     44.700
                                      3
                                                 southwest
                                                              11411.685000
                                             no
                                      3
1333
       50
              male
                     30.970
                                                 northwest
                                                              10600.548300
                                             no
                                      0
1334
        18
            female
                     31.920
                                                 northeast
                                                               2205.980800
                                             no
            female
                     36.850
                                      0
1335
        18
                                             no
                                                 southeast
                                                               1629.833500
1336
        21
            female
                     25.800
                                      0
                                                 southwest
                                                               2007.945000
                                             no
1337
            female
                     29.070
                                      0
                                            yes
                                                              29141.360300
                                                 northwest
```

[]: df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 7 columns):

```
#
         Column
                   Non-Null Count Dtype
                   1338 non-null
                                   int64
     0
         age
     1
         sex
                   1338 non-null
                                   object
     2
         bmi
                   1338 non-null
                                   float64
     3
         children 1338 non-null
                                   int64
     4
         smoker
                   1338 non-null
                                   object
     5
         region
                   1338 non-null
                                   object
         charges
                   1338 non-null
                                   float64
    dtypes: float64(2), int64(2), object(3)
    memory usage: 73.3+ KB
[]: T={"smoker":{'yes':1,'no':0}}
```

```
[]: T={"smoker":{'yes':1,'no':0}}
df=df.replace(T)
df
```

[]:	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	1	southwest	16884.924000
1	18	male	33.770	1	0	southeast	1725.552300
2	28	male	33.000	3	0	southeast	4449.462000
3	33	male	22.705	0	0	northwest	21984.470610
4	32	male	28.880	0	0	northwest	3866.855200
5	31	female	25.740	0	0	southeast	3756.621600
6	46	female	33.440	1	0	southeast	8240.589600
7	37	female	27.740	3	0	northwest	7281.505600
8	37	male	29.830	2	0	northeast	6406.410700
9	60	female	25.840	0	0	northwest	28923.136920
10	25	male	26.220	0	0	northeast	2721.320800
11	62	female	26.290	0	1	southeast	27808.725100
12	23	male	34.400	0	0	southwest	1826.843000
13	56	female	39.820	0	0	southeast	11090.717800
14	27	male	42.130	0	1	southeast	39611.757700
15	19	male	24.600	1	0	southwest	1837.237000
16	52	female	30.780	1	0	northeast	10797.336200
17	23	male	23.845	0	0	northeast	2395.171550
18	56	male	40.300	0	0	southwest	10602.385000
19	30	male	35.300	0	1	southwest	36837.467000
20	60	female	36.005	0	0	northeast	13228.846950
21	30	female	32.400	1	0	southwest	4149.736000
22	18	male	34.100	0	0	southeast	1137.011000
23	34	female	31.920	1	1	northeast	37701.876800
24	37	male	28.025	2	0	northwest	6203.901750
25	59	female	27.720	3	0	southeast	14001.133800
26	63	female	23.085	0	0	northeast	14451.835150
27	55	female	32.775	2	0	northwest	12268.632250
28	23	male	17.385	1	0	northwest	2775.192150
29	31	male	36.300	2	1	southwest	38711.000000

```
1299
             19
                  female
                           25.745
                                            1
                                                     0
                                                        northwest
                                                                      2710.828550
             45
                                            0
     1300
                           30.360
                                                     1
                    male
                                                        southeast
                                                                     62592.873090
                                            3
     1301
             62
                    male
                           30.875
                                                     1
                                                        northwest
                                                                     46718.163250
     1302
             25
                  female
                           20.800
                                            1
                                                     0
                                                        southwest
                                                                      3208.787000
     1303
             43
                           27.800
                                            0
                    male
                                                     1
                                                        southwest
                                                                     37829.724200
                                            2
     1304
             42
                    male
                           24.605
                                                     1
                                                        northeast
                                                                     21259.377950
             24
                           27.720
                                            0
                                                     0
     1305
                 female
                                                        southeast
                                                                      2464.618800
                                            0
     1306
             29
                  female
                           21.850
                                                     1
                                                        northeast
                                                                     16115.304500
                           28.120
                                            4
     1307
             32
                                                     1
                                                        northwest
                                                                     21472.478800
                    male
                           30.200
                                            0
                                                     1
     1308
             25
                  female
                                                        southwest
                                                                     33900.653000
                                            2
                           32.200
                                                     0
     1309
             41
                    male
                                                        southwest
                                                                      6875.961000
     1310
             42
                    male
                           26.315
                                            1
                                                     0
                                                        northwest
                                                                      6940.909850
     1311
             33
                 female
                           26.695
                                            0
                                                     0
                                                        northwest
                                                                      4571.413050
     1312
             34
                    male
                           42.900
                                            1
                                                     0
                                                        southwest
                                                                      4536.259000
                                            2
     1313
                           34.700
                                                     1
                                                        southwest
                                                                     36397.576000
             19
                  female
     1314
             30
                  female
                           23.655
                                            3
                                                     1
                                                        northwest
                                                                     18765.875450
                                            1
                                                     0
     1315
             18
                    male
                           28.310
                                                        northeast
                                                                     11272.331390
                                            0
                                                     0
     1316
             19
                  female
                           20.600
                                                        southwest
                                                                      1731.677000
                                            0
                                                     0
     1317
             18
                    male
                           53.130
                                                        southeast
                                                                      1163.462700
     1318
                           39.710
                                            4
                                                     0
                                                                     19496.719170
             35
                    male
                                                        northeast
                                            2
                                                     0
     1319
             39
                 female
                           26.315
                                                        northwest
                                                                      7201.700850
                                            3
                                                     0
     1320
             31
                    male
                           31.065
                                                        northwest
                                                                      5425.023350
     1321
             62
                           26.695
                                            0
                                                     1
                                                                     28101.333050
                    male
                                                        northeast
                                            0
                                                     0
     1322
             62
                    male
                           38.830
                                                        southeast
                                                                     12981.345700
     1323
                  female
                           40.370
                                            2
                                                     1
                                                        southeast
                                                                     43896.376300
             42
     1324
             31
                    male
                           25.935
                                            1
                                                     0
                                                        northwest
                                                                      4239.892650
     1325
                           33.535
             61
                    male
                                            0
                                                     0
                                                        northeast
                                                                     13143.336650
             42
                           32.870
                                            0
                                                     0
     1326
                 female
                                                        northeast
                                                                      7050.021300
                                                        southeast
     1327
             51
                    male
                           30.030
                                            1
                                                     0
                                                                      9377.904700
                           24.225
                                            2
                                                     0
     1328
             23
                 female
                                                        northeast
                                                                     22395.744240
                                            2
                                                     0
     1329
             52
                    male
                           38.600
                                                        southwest
                                                                     10325.206000
                                            2
                                                     0
     1330
             57
                           25.740
                                                        southeast
                                                                     12629.165600
                  female
                                            0
                                                     0
     1331
             23
                  female
                           33.400
                                                        southwest
                                                                     10795.937330
                                            3
                                                     0
     1332
             52
                  female
                           44.700
                                                        southwest
                                                                     11411.685000
                                            3
     1333
             50
                           30.970
                                                     0
                                                                     10600.548300
                    male
                                                        northwest
     1334
             18
                 female
                           31.920
                                            0
                                                     0
                                                        northeast
                                                                      2205.980800
                                            0
                                                     0
     1335
             18
                 female
                           36.850
                                                        southeast
                                                                      1629.833500
     1336
             21
                  female
                                            0
                                                     0
                                                                      2007.945000
                           25.800
                                                        southwest
     1337
             61
                  female
                           29.070
                                            0
                                                        northwest
                                                                     29141.360300
[]: T={"sex":{'male':1,'female':0}}
     df=df.replace(T)
[]:
                           bmi
                                children
                                            smoker
                                                        region
                                                                       charges
            age
                  sex
```

1

0

southwest

southeast

16884.924000

1725.552300

0

1

0

1

0

1

19

18

27.900

33.770

_					_		
2	28	1	33.000	3	0	southeast	4449.462000
3	33	1	22.705	0	0	northwest	21984.470610
4	32	1	28.880	0	0	northwest	3866.855200
5	31	0	25.740	0	0	southeast	3756.621600
6	46	0	33.440	1	0	southeast	8240.589600
7	37	0	27.740	3	0	northwest	7281.505600
8	37	1	29.830	2	0	northeast	6406.410700
9	60	0	25.840	0	0	northwest	28923.136920
10	25	1	26.220	0	0	northeast	2721.320800
11	62	0	26.290	0	1	southeast	27808.725100
						southwest	
12	23	1	34.400	0	0		1826.843000
13	56	0	39.820	0	0	southeast	11090.717800
14	27	1	42.130	0	1	southeast	39611.757700
15	19	1	24.600	1	0	southwest	1837.237000
16	52	0	30.780	1	0	northeast	10797.336200
17	23	1	23.845	0	0	northeast	2395.171550
18	56	1	40.300	0	0	southwest	10602.385000
19	30	1	35.300	0	1	southwest	36837.467000
20	60	0	36.005	0	0	northeast	13228.846950
21	30	0	32.400	1	0	southwest	4149.736000
22	18	1	34.100	0	0	southeast	1137.011000
23	34	0	31.920	1	1	northeast	37701.876800
24	37	1	28.025	2	0	northwest	6203.901750
25	59	0	27.720	3	0	southeast	14001.133800
26	63	0	23.085	0	0	northeast	14451.835150
		0	32.775	2		northwest	12268.632250
27	55			1	0		
28	23	1	17.385		0	northwest	2775.192150
29	31	1	36.300	2	1	southwest	38711.000000
30	22	1	35.600	0	1	southwest	35585.576000
31	18	0	26.315	0	0	northeast	2198.189850
32	19	0	28.600	5	0	southwest	4687.797000
33	63	1	28.310	0	0	northwest	13770.097900
34	28	1	36.400	1	1	southwest	51194.559140
35	19	1	20.425	0	0	northwest	1625.433750
36	62	0	32.965	3	0	northwest	15612.193350
37	26	1	20.800	0	0	southwest	2302.300000
38	35	1	36.670	1	1	northeast	39774.276300
39	60	1	39.900	0	1	southwest	48173.361000
40	24	0	26.600	0	0	northeast	3046.062000
41	31	0	36.630	2	0	southeast	4949.758700
42	41	1	21.780	1	0	southeast	6272.477200
43	37	0	30.800	2	0	southeast	6313.759000
						northeast	
44 45	38 55	1	37.050	1	0	southwest	6079.671500
45 46	55 10	1	37.300	0	0		20630.283510
46	18	0	38.665	2	0	northeast	3393.356350
47	28	0	34.770	0	0	northwest	3556.922300
48	60	0	24.530	0	0	southeast	12629.896700

```
1318
            35
                 1 39.710
                                   4
                                           0 northeast 19496.719170
                    26.315
                                    2
    1319
            39
                                           0 northwest
                                                          7201.700850
    1320
            31
                 1 31.065
                                   3
                                             northwest
                                                          5425.023350
    1321
            62
                 1 26.695
                                   0
                                              northeast
                                                         28101.333050
    1322
                 1 38.830
                                   0
                                              southeast 12981.345700
            62
    1323
           42
                 0 40.370
                                   2
                                            1
                                              southeast
                                                        43896.376300
    1324
                 1 25.935
                                           0 northwest
           31
                                    1
                                                         4239.892650
    1325
            61
                 1 33.535
                                   0
                                           0 northeast 13143.336650
    1326
                 0 32.870
                                           0 northeast 7050.021300
           42
                                   0
    1327
                 1 30.030
                                    1
                                             southeast
                                                          9377.904700
           51
                 0 24.225
                                   2
                                           0 northeast 22395.744240
    1328
            23
    1329
            52
                 1 38.600
                                   2
                                           0 southwest 10325.206000
                                           0 southeast 12629.165600
    1330
           57
                 0 25.740
                                   2
    1331
           23
                 0 33.400
                                   0
                                           0 southwest 10795.937330
                 0 44.700
                                   3
    1332
            52
                                              southwest 11411.685000
    1333
           50
                 1 30.970
                                   3
                                           0 northwest 10600.548300
    1334
                 0 31.920
                                   0
                                           0 northeast
                                                         2205.980800
            18
                 0 36.850
    1335
                                   0
                                           0 southeast
            18
                                                          1629.833500
                                    0
    1336
            21
                 0 25.800
                                              southwest
                                                          2007.945000
    1337
                    29.070
                                              northwest 29141.360300
           61
[]: from sklearn.model_selection import train_test_split
    x_train,x_test,y_train,y_test=train_test_split(x,y,train_size=0.
      →7,random_state=42)
[]: x=np.array(df['bmi']).reshape(-1,1)
    y=np.array(df['smoker']).reshape(-1,1)
[]: from sklearn.ensemble import RandomForestClassifier
    rfc=RandomForestClassifier()
    rfc.fit(x,y)
    <ipython-input-91-ee86071c5c26>:3: DataConversionWarning: A column-vector y was
    passed when a 1d array was expected. Please change the shape of y to
    (n_samples,), for example using ravel().
      rfc.fit(x,y)
[ ]: RandomForestClassifier()
[]: rf=RandomForestClassifier()
[]: params={'max_depth':[2,3,5,10,20],
     'min_samples_leaf':[5,10,20,50,100,200],
     'n_estimators':[10,25,30,50,100,200]}
[]: from sklearn.model_selection import GridSearchCV
    grid_search=GridSearchCV(estimator=rf,param_grid=params,cv=2,scoring='accuracy')
```

```
grid_search.fit(x,y)
```

```
/usr/local/lib/python3.10/dist-
packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
/usr/local/lib/python3.10/dist-
packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
/usr/local/lib/python3.10/dist-
packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
/usr/local/lib/python3.10/dist-
packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
/usr/local/lib/python3.10/dist-
packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
/usr/local/lib/python3.10/dist-
packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
/usr/local/lib/python3.10/dist-
packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
/usr/local/lib/python3.10/dist-
packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
/usr/local/lib/python3.10/dist-
packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
```

```
of y to (n_samples,), for example using ravel().
      estimator.fit(X_train, y_train, **fit_params)
    /usr/local/lib/python3.10/dist-
    packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
    column-vector y was passed when a 1d array was expected. Please change the shape
    of y to (n_samples,), for example using ravel().
      estimator.fit(X_train, y_train, **fit_params)
    /usr/local/lib/python3.10/dist-
    packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
    column-vector y was passed when a 1d array was expected. Please change the shape
    of y to (n_samples,), for example using ravel().
      estimator.fit(X_train, y_train, **fit_params)
    /usr/local/lib/python3.10/dist-
    packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
    column-vector y was passed when a 1d array was expected. Please change the shape
    of y to (n_samples,), for example using ravel().
      estimator.fit(X_train, y_train, **fit_params)
    /usr/local/lib/python3.10/dist-
    packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
    column-vector y was passed when a 1d array was expected. Please change the shape
    of y to (n_samples,), for example using ravel().
      estimator.fit(X_train, y_train, **fit_params)
    /usr/local/lib/python3.10/dist-
    packages/sklearn/model_selection/_validation.py:686: DataConversionWarning: A
    column-vector y was passed when a 1d array was expected. Please change the shape
    of y to (n_samples,), for example using ravel().
      estimator.fit(X_train, y_train, **fit_params)
    /usr/local/lib/python3.10/dist-packages/sklearn/model_selection/_search.py:909:
    DataConversionWarning: A column-vector y was passed when a 1d array was
    expected. Please change the shape of y to (n_samples,), for example using
    ravel().
      self.best_estimator_.fit(X, y, **fit_params)
[]: GridSearchCV(cv=2, estimator=RandomForestClassifier(),
                  param_grid={'max_depth': [2, 3, 5, 10, 20],
                              'min_samples_leaf': [5, 10, 20, 50, 100, 200],
                              'n_estimators': [10, 25, 30, 50, 100, 200]},
                  scoring='accuracy')
[]: grid_search.best_score_
[]: 0.7952167414050823
[]: rf_best=grid_search.best_estimator_
     print(rf_best)
```

RandomForestClassifier(max depth=2, min samples leaf=5, n estimators=10)

```
plt.figure(figsize=(80,40))
            plot_tree(rf_best_estimators_[5],class_names=['0','1'],filled=True)
[]: [Text(0.5, 0.83333333333333334, 'x[0] \le 24.938 \rangle = 0.298 
            835\nvalue = [1094, 244]\nclass = 0'),
              Text(0.25, 0.5, 'x[0] \le 21.68 \cdot ngini = 0.369 \cdot nsamples = 162 \cdot nvalue = [183, nsamples = 1
            59] \nclass = 0'),
              13]\nclass = 0'),
              46] \nclass = 0'),
              Text(0.75, 0.5, 'x[0] \le 26.255  ngini = 0.281 \ nsamples = 673 \ nvalue = [911,
            185]\nclass = 0'),
              6] \nclass = 0'),
              179] \nclass = 0')
                                                                                                 x[0] \le 24.938
                                                                                                    gini = 0.298
                                                                                                  samples = 835
                                                                                             value = [1094, 244]
                                                                                                        class = 0
                                                    x[0] \le 21.68
                                                                                                                                                x[0] \le 26.255
                                                      gini = 0.369
                                                                                                                                                   gini = 0.281
                                                   samples = 162
                                                                                                                                                samples = 673
                                                 value = [183, 59]
                                                                                                                                            value = [911, 185]
                                                          class = 0
                                                                                                                                                      class = 0
                                                                              gini = 0.419
                               gini = 0.252
                                                                                                                            gini = 0.137
                                                                                                                                                                          gini = 0.291
                              samples = 58
                                                                           samples = 104
                                                                                                                          samples = 60
                                                                                                                                                                       samples = 613
                           value = [75, 13]
                                                                        value = [108, 46]
                                                                                                                         value = [75, 6]
                                                                                                                                                                   value = [836, 179]
                                   class = 0
                                                                                 class = 0
                                                                                                                               class = 0
                                                                                                                                                                             class = 0
[]: rf_best.feature_importances_
[]: array([1.])
[]: imp_df=pd.DataFrame({"Imp":rf_best.feature_importances_})
            imp_df.sort_values(by="Imp",ascending=False)
[]:
                   Imp
            0 1.0
```

[]: from sklearn.tree import plot_tree

CONCLUSION:-

THE SCORE OF RANDOM FOREST IS :- 1.0

-> BY COMPARING ALL THE ABOVE MODELS

#WE CAN CONCLUDE THAT LOGISTIC REGRESSION HAS HIGHEST ACCURACY. SO WE CAN PREFER LOGISTIC REGRESSION FOR THIS DATASET