MINI PROJECT

PROBLEM STATEMENT : Which model is suitable for insurance test Importing Packages

Read the Data

In [ ]:

```
```

In [39]:

```
#importing packages
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:

```
df=pd.read_csv(r"C:\Users\DHEEPAK\Desktop\insurance.csv")
print(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]
```

Data Collection and Preprocessing

In [3]:

```
df.head()
```

Out[3]:

	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

In [4]:

```
df.tail()
```

Out[4]:

	age	sex	bmi	children	smoker	region	charges
1333	50	male	30.97	3	no	northwest	10600.5483
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

In [5]:

```
df.shape
```

Out[5]:

```
(1338, 7)
```

In [6]:

```
df.describe()
```

Out[6]:

	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

In [7]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 7 columns):
 #   Column    Non-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
dtypes: float64(2), int64(2), object(3)
memory usage: 73.3+ KB
```

In [8]:

```
#to check null values
df.isnull().sum()
```

Out[8]:

```
age         0
sex         0
bmi         0
children    0
smoker      0
region      0
charges     0
dtype: int64
```

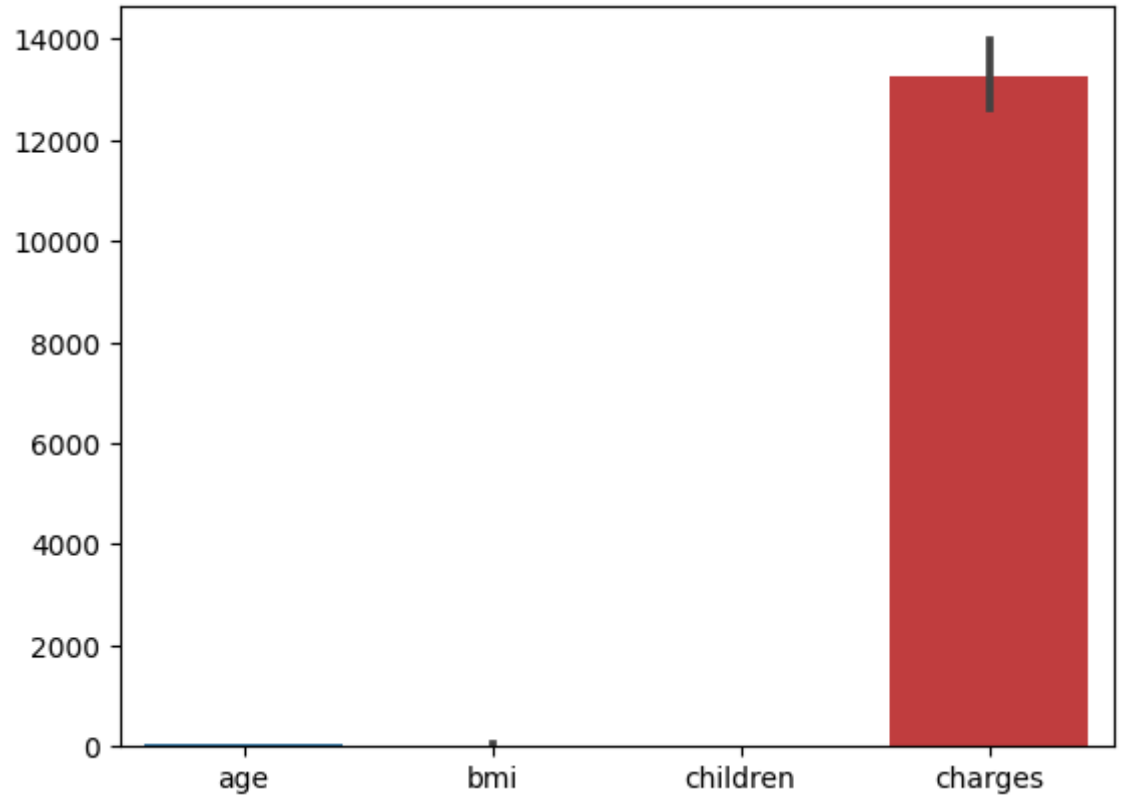
Data Visualization

In [9]:

```
#Exploratory Data Analysis
sns.barplot(df)
```

Out[9]:

```
<Axes: >
```



In [10]:

```
df.columns
```

Out[10]:

```
Index(['age', 'sex', 'bmi', 'children', 'smoker', 'region', 'charges'], dt
ype='object')
```

In [11]:

```
smoker={"smoker":{"yes":1,"no":0}}
df=df.replace(smoker)
df
```

Out[11]:

	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	1	southwest	16884.92400
1	18	male	33.770	1	0	southeast	1725.55230
2	28	male	33.000	3	0	southeast	4449.46200
3	33	male	22.705	0	0	northwest	21984.47061
4	32	male	28.880	0	0	northwest	3866.85520
...	...	...	...	...	...	...	...
1333	50	male	30.970	3	0	northwest	10600.54830
1334	18	female	31.920	0	0	northeast	2205.98080
1335	18	female	36.850	0	0	southeast	1629.83350
1336	21	female	25.800	0	0	southwest	2007.94500
1337	61	female	29.070	0	1	northwest	29141.36030

1338 rows × 7 columns

In [12]:

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

Out[12]:

	age	sex	bmi	children	smoker	region	charges
0	19	0	27.900	0	1	southwest	16884.92400
1	18	1	33.770	1	0	southeast	1725.55230
2	28	1	33.000	3	0	southeast	4449.46200
3	33	1	22.705	0	0	northwest	21984.47061
4	32	1	28.880	0	0	northwest	3866.85520
...	...	...	...	...	...	...	...
1333	50	1	30.970	3	0	northwest	10600.54830
1334	18	0	31.920	0	0	northeast	2205.98080
1335	18	0	36.850	0	0	southeast	1629.83350
1336	21	0	25.800	0	0	southwest	2007.94500
1337	61	0	29.070	0	1	northwest	29141.36030

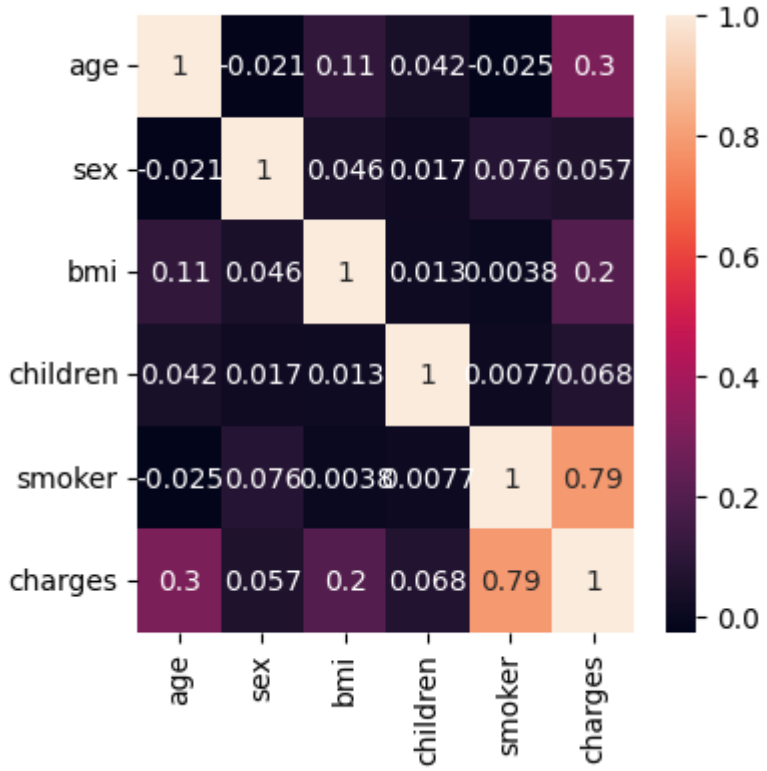
1338 rows × 7 columns

In [13]:

```
idf=df[['age', 'sex', 'bmi', 'children', 'smoker', 'charges']]
plt.figure(figsize=(4,4))
sns.heatmap(idf.corr(),annot=True)
```

Out[13]:

<Axes: >



Feature Scaling : To Split the data into training data and test data

In [14]:

```
#Training the model
X=df[['age', 'sex', 'bmi', 'children', 'smoker']]
y=df['charges']
```

Applying Linear Regression

In [15]:

```
#Linear Regression
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.3,random_state=100)
```

In [16]:

```
from sklearn.linear_model import LinearRegression
regr=LinearRegression()
regr.fit(X_train,y_train)
print(regr.intercept_)
coeff_df=pd.DataFrame(regr.coef_,X.columns,columns=['coefficient'])
coeff_df
```

```
-10719.483493479498
```

Out[16]:

	coefficient
age	259.757578
sex	18.216925
bmi	277.903898
children	461.169867
smoker	23981.741027

In [17]:

```
score=regr.score(X_test,y_test)
print(score)
```

```
0.780095696440481
```

In [18]:

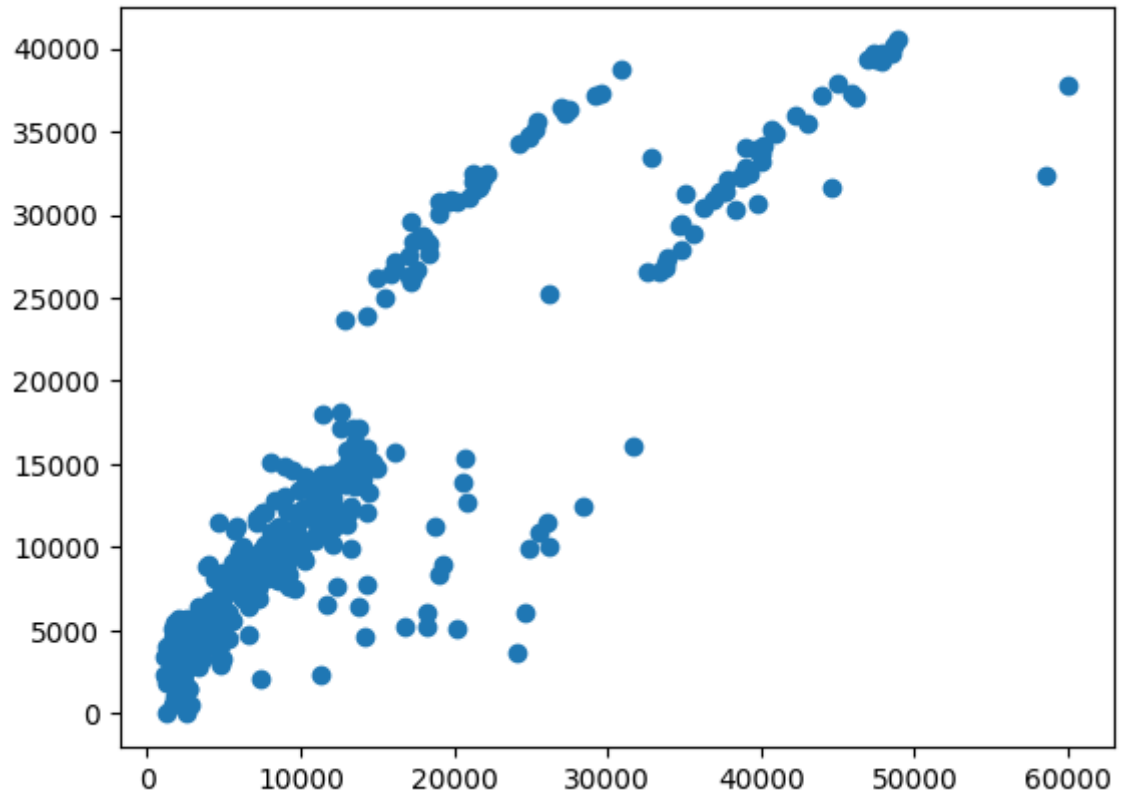
```
predictions=regr.predict(X_test)
```

In [19]:

```
plt.scatter(y_test,predictions)
```

Out[19]:

```
<matplotlib.collections.PathCollection at 0x2172b1e3550>
```



In [20]:

```
x=np.array(df['smoker']).reshape(-1,1)
y=np.array(df['charges']).reshape(-1,1)
df.dropna(inplace=True)
```

In [21]:

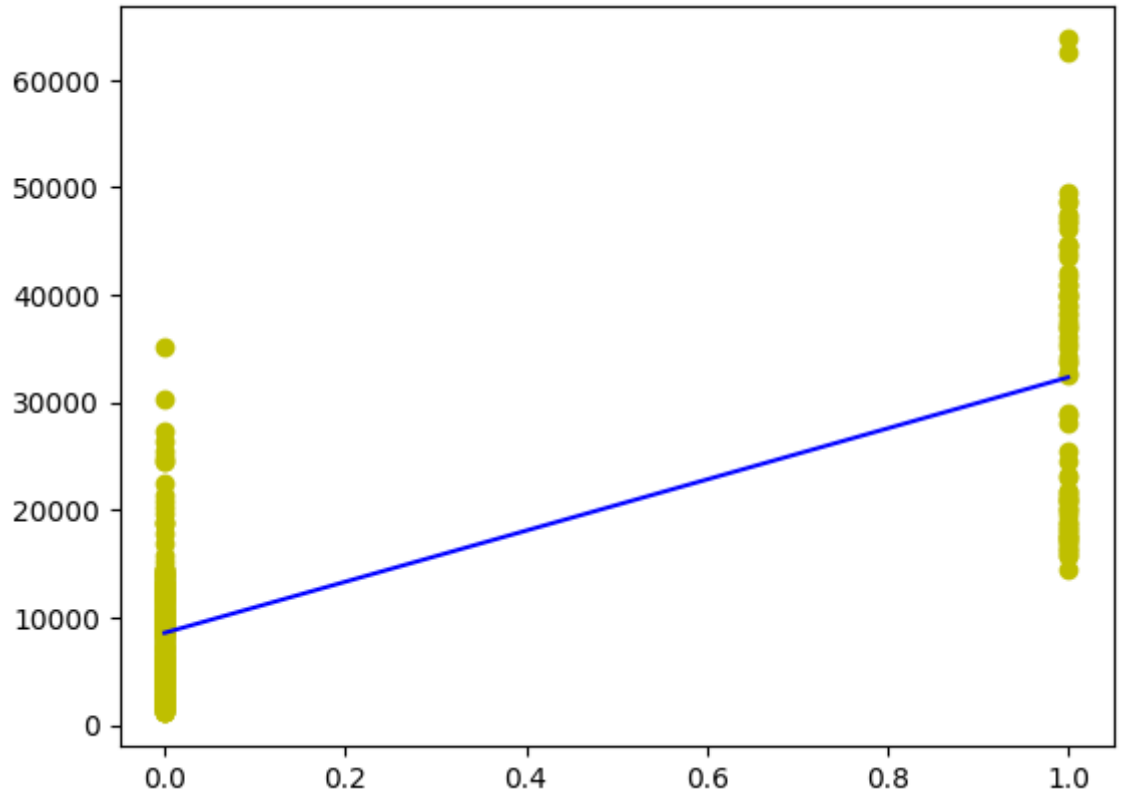
```
X_train,X_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
regr.fit(X_train,y_train)
regr.fit(X_train,y_train)
```

Out[21]:

```
▾ LinearRegression
LinearRegression()
```

In [22]:

```
y_pred=regr.predict(X_test)
plt.scatter(X_test,y_test,color='y')
plt.plot(X_test,y_pred,color='b')
plt.show()
```



Since we did not get the accuracy for Linear Regression we are going to -implement Logistic Regression

Logistic Regression

In [23]:

```
#Logistic Regression
x=np.array(df['charges']).reshape(-1,1)
y=np.array(df['smoker']).reshape(-1,1)
df.dropna(inplace=True)
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3,random_state=1)
from sklearn.linear_model import LogisticRegression
lr=LogisticRegression(max_iter=10000)
```

In [24]:

```
lr.fit(x_train,y_train)
```

```
C:\Users\DHEEPAK\AppData\Local\Programs\Python\Python311\Lib\site-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)
```

Out[24]:

```
LogisticRegression
LogisticRegression(max_iter=10000)
```

In [25]:

```
score=lr.score(x_test,y_test)
print(score)
```

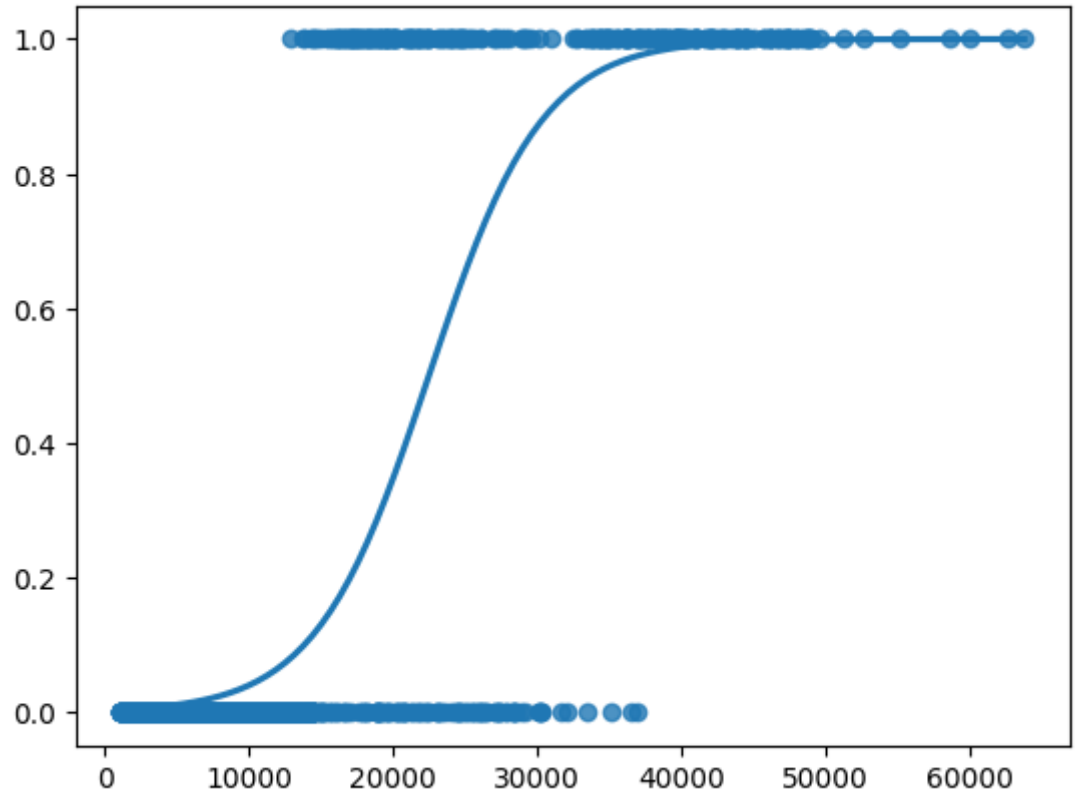
```
0.8930348258706468
```

In [26]:

```
sns.regplot(x=x,y=y,data=df,logistic=True,ci=None)
```

Out[26]:

```
<Axes: >
```



We got the best fit curve for Logistic Regression .Now we are going to check that if we may get better accuracy by implementing Decision Tree and Random Forest

Decision Tree

In [27]:

```
pip install statsmodels
```

```
Requirement already satisfied: statsmodels in c:\users\dheepak\appdata\loc
al\programs\python\python311\lib\site-packages (0.14.0)
Requirement already satisfied: numpy>=1.18 in c:\users\dheepak\appdata\loc
al\programs\python\python311\lib\site-packages (from statsmodels) (1.24.3)
Requirement already satisfied: scipy!=1.9.2,>=1.4 in c:\users\dheepak\appd
ata\local\programs\python\python311\lib\site-packages (from statsmodels)
(1.10.1)
Requirement already satisfied: pandas>=1.0 in c:\users\dheepak\appdata\loc
al\programs\python\python311\lib\site-packages (from statsmodels) (2.0.1)
Requirement already satisfied: patsy>=0.5.2 in c:\users\dheepak\appdata\lo
cal\programs\python\python311\lib\site-packages (from statsmodels) (0.5.3)
Requirement already satisfied: packaging>=21.3 in c:\users\dheepak\appdata
\local\programs\python\python311\lib\site-packages (from statsmodels) (23.
1)
Requirement already satisfied: python-dateutil>=2.8.2 in c:\users\dheepak
\appdata\local\programs\python\python311\lib\site-packages (from pandas>=
1.0->statsmodels) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\users\dheepak\appdata\lo
cal\programs\python\python311\lib\site-packages (from pandas>=1.0->statsmo
dels) (2023.3)
Requirement already satisfied: tzdata>=2022.1 in c:\users\dheepak\appdata
\local\programs\python\python311\lib\site-packages (from pandas>=1.0->stat
smodels) (2023.3)
Requirement already satisfied: six in c:\users\dheepak\appdata\local\progr
ams\python\python311\lib\site-packages (from patsy>=0.5.2->statsmodels)
(1.16.0)
Note: you may need to restart the kernel to use updated packages.


[notice] A new release of pip available: 22.3.1 -> 23.1.2
[notice] To update, run: python.exe -m pip install --upgrade pip
```

In [28]:

```
#Decision tree
from sklearn.tree import DecisionTreeClassifier
clf=DecisionTreeClassifier(random_state=0)
clf.fit(x_train,y_train)
```

Out[28]:

```
DecisionTreeClassifier
DecisionTreeClassifier(random_state=0)
```

Random Forest

In [29]:

```
score=clf.score(x_test,y_test)
print(score)
```

```
0.8880597014925373
```

In [30]:

```
#Random forest classifier
from sklearn.ensemble import RandomForestClassifier
rfc=RandomForestClassifier()
rfc.fit(X_train,y_train)
```

```
C:\Users\DHEEPAK\AppData\Local\Temp\ipykernel_36604\1232785509.py:4: DataC
onversionWarning: A column-vector y was passed when a 1d array was expecte
d. Please change the shape of y to (n_samples,), for example using ravel
().
  rfc.fit(X_train,y_train)
```

Out[30]:

```
RandomForestClassifier
RandomForestClassifier()
```

In [31]:

```
params={'max_depth':[2,3,5,10,20],'min_samples_leaf':[5,10,20,50,100,200],'n_estimators'
```

In [32]:

```
from sklearn.model_selection import GridSearchCV
grid_search=GridSearchCV(estimator=rfc,param_grid=params,cv=2,scoring="accuracy")
```

In [33]:

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

```
C:\Users\DHEEPAK\AppData\Local\Programs\Python\Python311\Lib\site-packa
ges\sklearn\model_selection\_validation.py:686: DataConversionWarning:
A column-vector y was passed when a 1d array was expected. Please chang
e the shape of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
C:\Users\DHEEPAK\AppData\Local\Programs\Python\Python311\Lib\site-packa
ges\sklearn\model_selection\_validation.py:686: DataConversionWarning:
A column-vector y was passed when a 1d array was expected. Please chang
e the shape of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
C:\Users\DHEEPAK\AppData\Local\Programs\Python\Python311\Lib\site-packa
ges\sklearn\model_selection\_validation.py:686: DataConversionWarning:
A column-vector y was passed when a 1d array was expected. Please chang
e the shape of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
C:\Users\DHEEPAK\AppData\Local\Programs\Python\Python311\Lib\site-packa
ges\sklearn\model_selection\_validation.py:686: DataConversionWarning:
A column-vector y was passed when a 1d array was expected. Please chang
e the shape of y to (n_samples,), for example using ravel().
```

In [34]:

```
grid_search.best_score_
```

Out[34]:

```
0.7938034188034188
```

In [35]:

```
grid_search.best_score_
```

Out[35]:

```
0.7938034188034188
```

In [36]:

```
rf_best=grid_search.best_estimator_
rf_best
```

Out[36]:

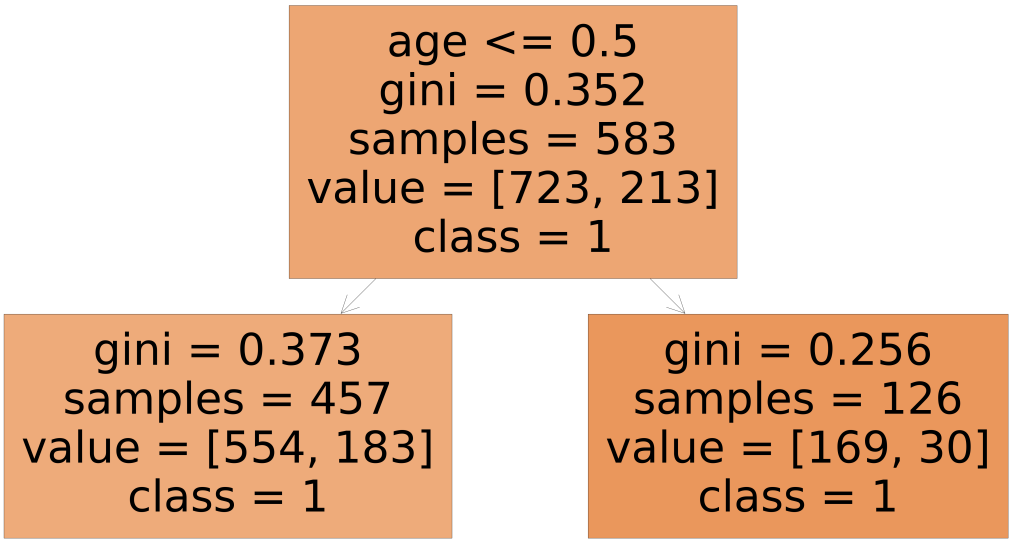
```
RandomForestClassifier
RandomForestClassifier(max_depth=2, min_samples_leaf=5, n_estimators=10)
```

In [37]:

```
from sklearn.tree import plot_tree
plt.figure(figsize=(80,40))
plot_tree(rf_best.estimators_[4],feature_names=X.columns,class_names=['1','0'],filled=Tr
```

Out[37]:

```
[Text(0.5, 0.75, 'age <= 0.5\ngini = 0.352\nsamples = 583\nvalue = [723, 2
13]\nclass = 1'),
 Text(0.25, 0.25, 'gini = 0.373\nsamples = 457\nvalue = [554, 183]\nclass
= 1'),
 Text(0.75, 0.25, 'gini = 0.256\nsamples = 126\nvalue = [169, 30]\nclass =
1')]
```



In [38]:

```
score=rfc.score(x_test,y_test)
print(score)
```

```
0.7985074626865671
```

CONCLUSION : Based on accuracy scores of all models that were implemented we can conclude that "Logistic Regression" is the best model for the given dataset

In [ ]: