Problem Statement: Predicting Health Insurance Costs

The objective of this project is to develop a predictive model using linear regression to estimate health insurance costs for individuals based on various factors. The dataset used for this analysis contains information about individuals, including their age, sex, BMI (Body Mass Index), number of children, smoking habits, and region.

The goals of this project are as follows: Data Preparation: Load and preprocess the insurance dataset, handling missing values, and encoding categorical variables appropriately. Feature Selection: Identify the relevant features that significantly affect health insurance costs. Perform any necessary feature engineering or transformation. Model Development: Split the dataset into training and test sets. Develop a linear regression model and train it using the training data. Model Evaluation: Evaluate the performance of the model by predicting the health insurance costs on the test set. Calculate the root mean squared error (RMSE) as a measure of prediction accuracy. Model Deployment: Once the model is trained and evaluated, it can be used to make predictions on new data points. Discuss the potential applications of the model, such as providing cost estimates for insurance companies or assisting individuals in understanding and planning for their health insurance expenses. Interpretation: Analyze the coefficients of the linear regression model to determine the impact of each feature on the predicted health insurance costs. Identify the most influential factors affecting insurance costs. By completing this project, we aim to develop a reliable model that can accurately estimate health insurance costs based on various factors. This model can provide valuable insights for insurance companies and individuals to make informed decisions regarding health insurance coverage and financial planning.

In [1]:
```
# import libraries
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
```

In [2]:
```
# read_data
df=pd.read_csv('insurance.csv')
```

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

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
...	...	...	...	...	...	...	...
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 × 7 columns

In [4]:
```
# to check shape
df.shape
```

Out[4]:
```
(1338, 7)
```

In [5]:
```
df.size
```

Out[5]:
```
9366
```

In [6]:
```
# info
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 [7]:
```
# to check datatypes
df.dtypes
```

Out[7]:
```
age           int64
sex          object
bmi         float64
children      int64
smoker       object
region       object
charges     float64
dtype: object
```

In [8]:
```
# correlation
cr=df.corr()
```

```
C:\Users\Pratik\AppData\Local\Temp\ipykernel_7412\3349988681.py:1: FutureWarning: The default value of numeric_only in DataFrame.corr is deprecated. In a future version, it will default to False. Select only valid columns or specify the value of numeric_only to silence this warning.
  cr=df.corr()
```

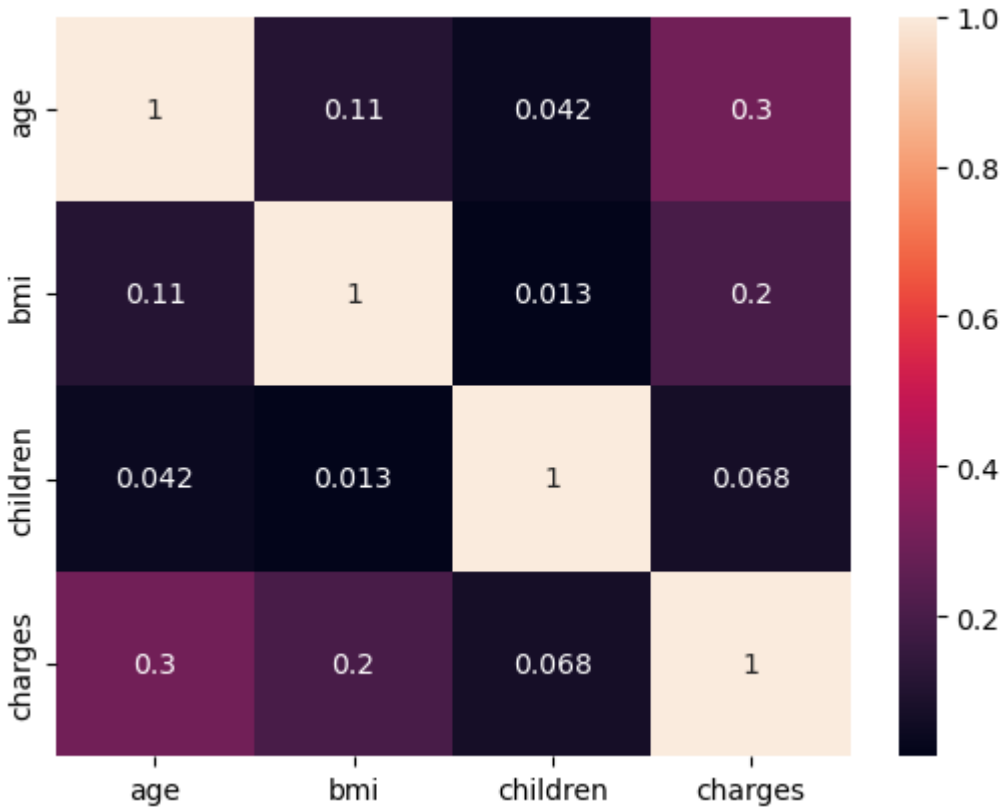
In [9]:
```
cr
```

Out[9]:

	age	bmi	children	charges
age	1.000000	0.109272	0.042469	0.299008
bmi	0.109272	1.000000	0.012759	0.198341
children	0.042469	0.012759	1.000000	0.067998
charges	0.299008	0.198341	0.067998	1.000000

In [10]:
```
sns.heatmap(cr,annot=True)
```

Out[10]:
```
<Axes: >
```



In [11]:
```
df['sex'].value_counts()
```

Out[11]:
```
male      676
female    662
Name: sex, dtype: int64
```

In [12]:
```
# to check stas info
df.describe()
```

Out[12]:

	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 [13]:
```
# handling null values
df.isnull().sum().sum()
```

Out[13]:
```
0
```

In [14]:
```
# handling duplicated values
df.duplicated().sum().sum()
```

Out[14]:
```
1
```

In [15]:
```
df.drop_duplicates(inplace=True,ignore_index=True)
```

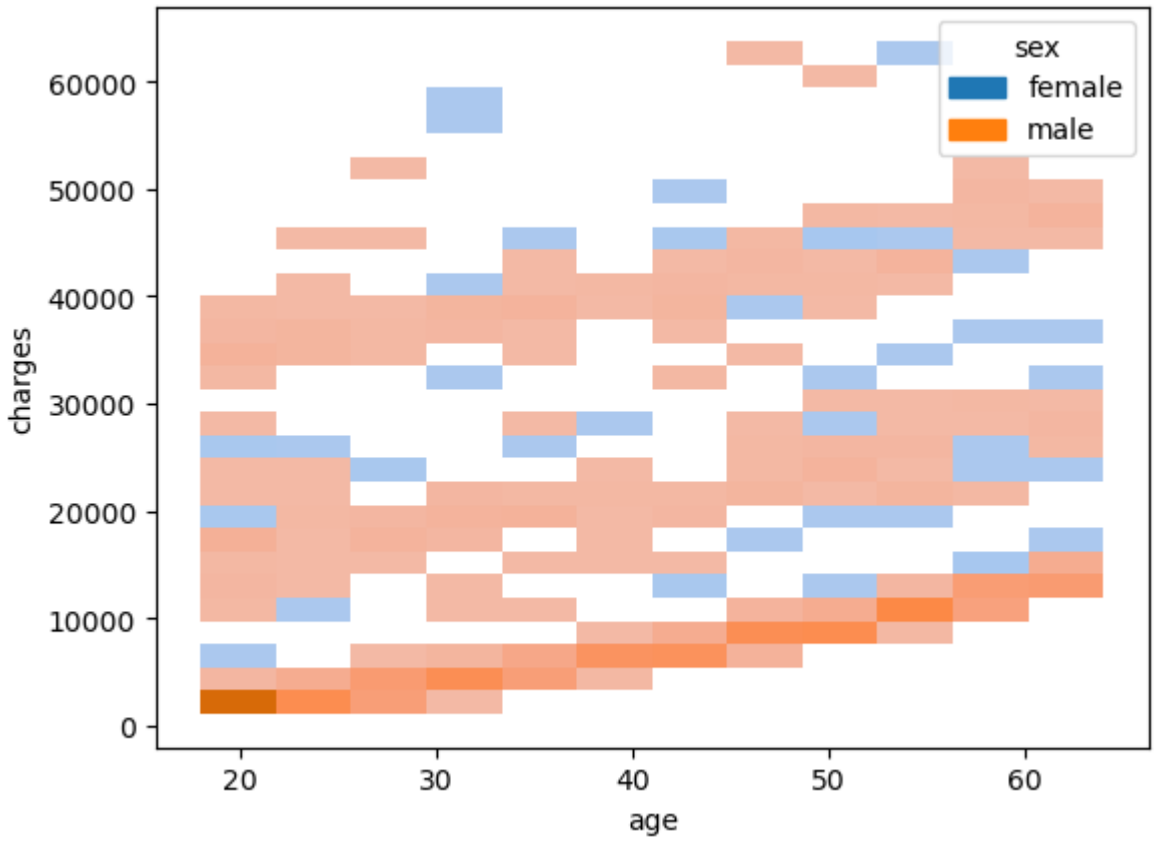
In [16]:
```
df.shape
```

Out[16]:
```
(1337, 7)
```

visualization

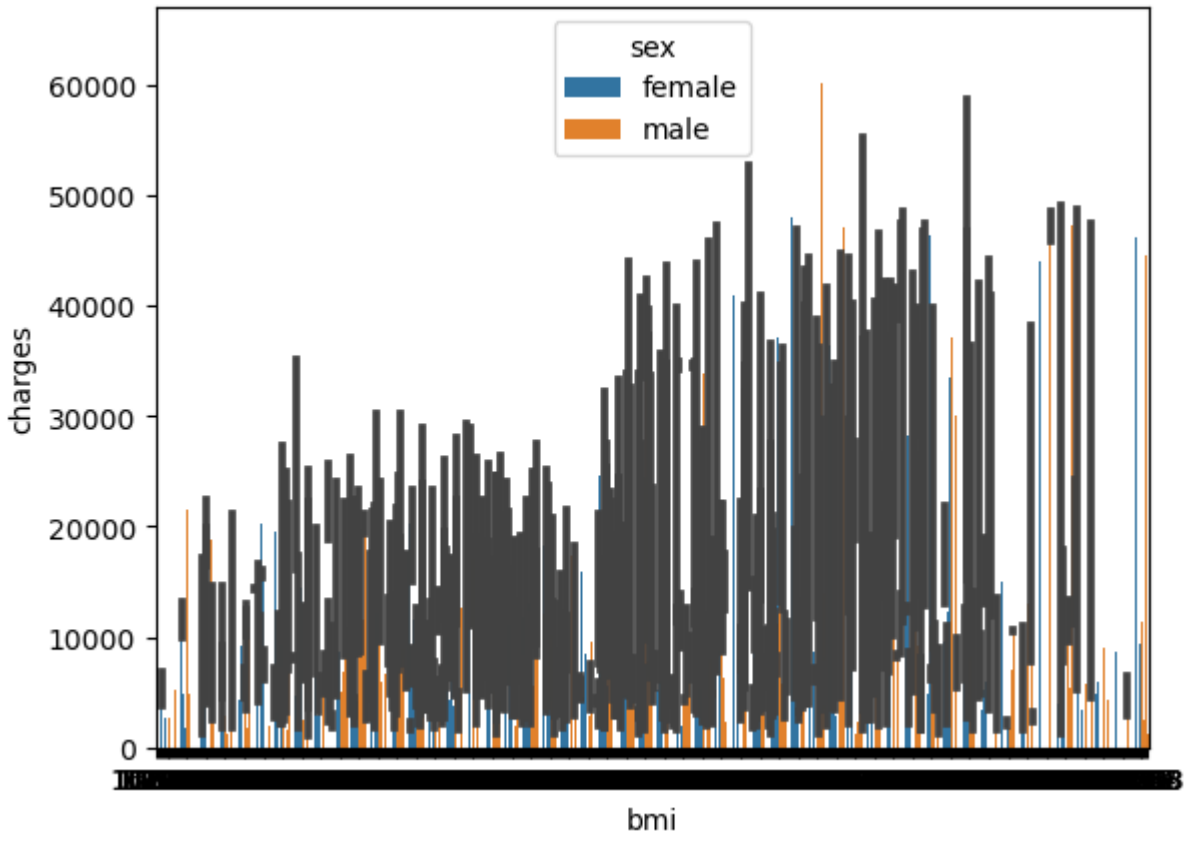
In [17]:
```
sns.histplot(x='age',y='charges',data=df,hue='sex')
```

Out[17]:
```
<Axes: xlabel='age', ylabel='charges'>
```



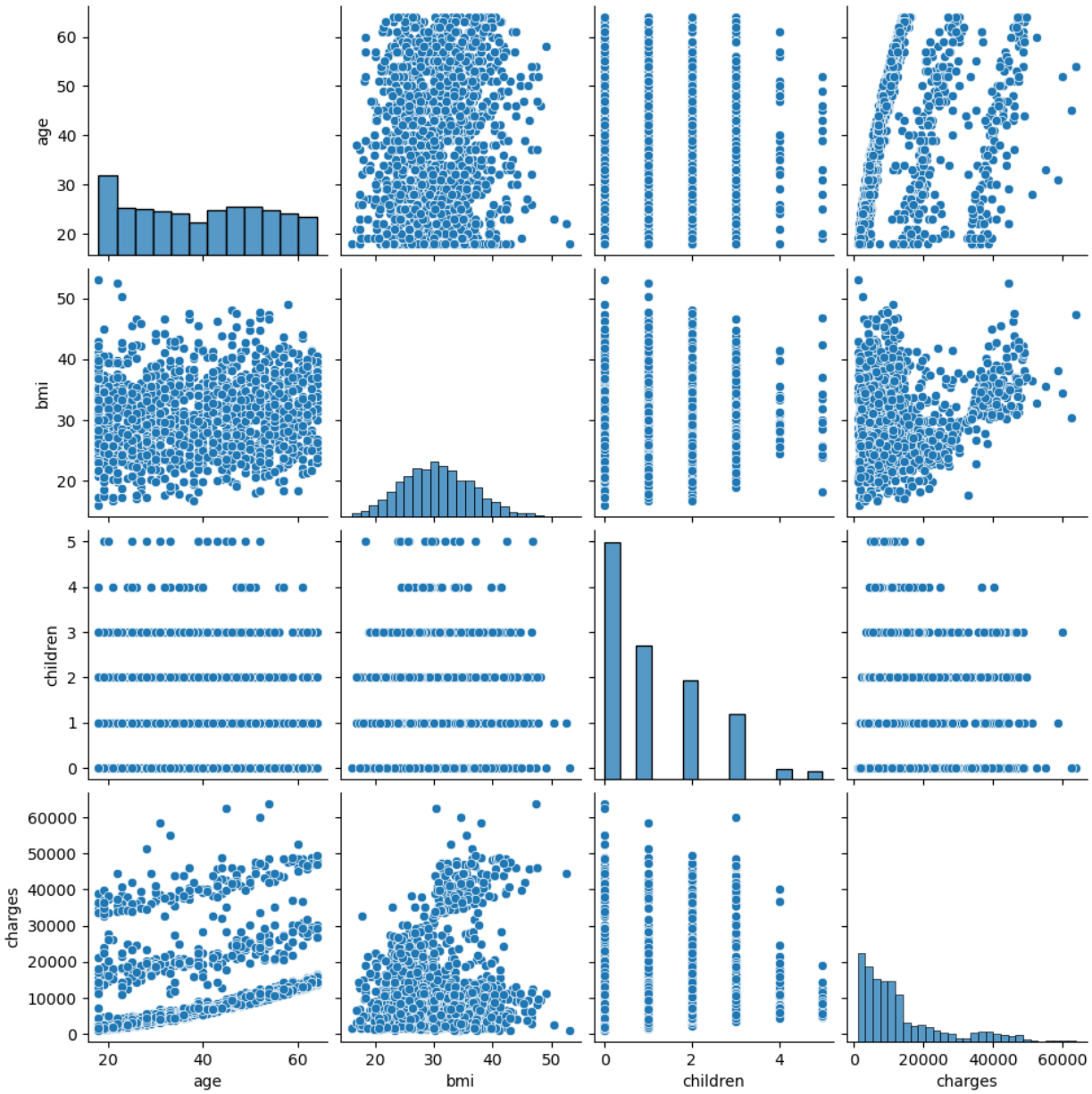
In [18]:
```
sns.barplot(x='bmi',y='charges',data=df,hue='sex')
```

Out[18]:
```
<Axes: xlabel='bmi', ylabel='charges'>
```



In [19]:
```
sns.pairplot(df)
```

Out[19]:
```
<seaborn.axisgrid.PairGrid at 0x2154524df90>
```



In [ ]:
```
# encoding
# get_dummies ,onehotencoding , leabelencoding
# but we use map method
```

In [20]:
```
df['sex']=df['sex'].map({'female':0,'male':1})
```

In [21]:
```
df['smoker']=df['smoker'].map({'yes':1,'no':0})
```

In [22]:
```
df
```

Out[22]:

	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
...	...	...	...	...	...	...	...
1332	50	1	30.970	3	0	northwest	10600.54830
1333	18	0	31.920	0	0	northeast	2205.98080
1334	18	0	36.850	0	0	southeast	1629.83350
1335	21	0	25.800	0	0	southwest	2007.94500
1336	61	0	29.070	0	1	northwest	29141.36030

1337 rows × 7 columns

In [23]:
```
df['region'].unique()
```

Out[23]:
```
array(['southwest', 'southeast', 'northwest', 'northeast'], dtype=object)
```

In [24]:
```
df['region']=df['region'].map({'southwest':0,'southeast':1,'northwest':2,'northeast':3
```

In [25]:
```
df
```

Out[25]:

	age	sex	bmi	children	smoker	region	charges
0	19	0	27.900	0	1	0	16884.92400
1	18	1	33.770	1	0	1	1725.55230
2	28	1	33.000	3	0	1	4449.46200
3	33	1	22.705	0	0	2	21984.47061
4	32	1	28.880	0	0	2	3866.85520
...	...	...	...	...	...	...	...
1332	50	1	30.970	3	0	2	10600.54830
1333	18	0	31.920	0	0	3	2205.98080
1334	18	0	36.850	0	0	1	1629.83350
1335	21	0	25.800	0	0	0	2007.94500
1336	61	0	29.070	0	1	2	29141.36030

1337 rows × 7 columns

In [26]:
```
# seperate X and y
X=df.drop('charges',axis=1)
```

In [27]:
```
y=df['charges']
```

In [33]:
```
# scaling
from sklearn.preprocessing import StandardScaler
sc=StandardScaler()
X_sc=sc.fit_transform(X)
```

In [35]:
```
X_sc
```

Out[35]:
```
array([[-1.44041773, -1.00977099, -0.45315959, -0.90923416,  1.96966039,
        -1.34316271],
       [-1.51164747,  0.99032355,  0.50942165, -0.07944162, -0.50770174,
        -0.43801727],
       [-0.79935006,  0.99032355,  0.3831546 ,  1.58014347, -0.50770174,
        -0.43801727],
       ...,
       [-1.51164747, -1.00977099,  1.01448983, -0.90923416, -0.50770174,
        -0.43801727],
       [-1.29795825, -1.00977099, -0.79752426, -0.90923416, -0.50770174,
        -1.34316271],
       [ 1.55123139, -1.00977099, -0.26129928, -0.90923416,  1.96966039,
         0.46712816]])
```

In [39]:
```
# cross validation
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test=train_test_split(X_sc,y,test_size=0.2,random_state=11)
```

In [40]:
```
print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(1069, 6)
(268, 6)
(1069,)
(268,)
```

In [44]:
```
# moddel training
from sklearn.linear_model import LinearRegression
lr=LinearRegression()
lr.fit(X_train,y_train)
```

Out[44]:
```
▾ LinearRegression
LinearRegression()
```

In [45]:
```
lr.score(X_test,y_test)
```

Out[45]:
```
0.8140764981210222
```

In [47]:
```
# svr
from sklearn.svm import SVR
svm=SVR()
svm.fit(X_train,y_train)
```

Out[47]:
```
SVR()
```

In [48]:
```
svm.score(X_test,y_test)
```

Out[48]:
```
-0.042675208415232424
```

In [53]:
```
# decison tree
from sklearn.tree import DecisionTreeRegressor
dt=DecisionTreeRegressor()
dt.fit(X_train,y_train)
```

Out[53]:
```
DecisionTreeRegressor()
```

In [54]:
```
dt.score(X_test,y_test)
```

Out[54]:
```
0.6987780814352922
```

In [63]:
```
#Random ForestRegressor
from sklearn.ensemble import RandomForestRegressor
rf=RandomForestRegressor()
rf.fit(X_train,y_train)
```

Out[63]:
```
RandomForestRegressor()
```

In [64]:
```
#GradientBoostingRegressor
from sklearn.ensemble import GradientBoostingRegressor
gb=GradientBoostingRegressor()
gb.fit(X_train,y_train)
```

Out[64]:
```
GradientBoostingRegressor()
```

In [65]:
```
y_pred1=lr.predict(X_test)
y_pred2=svm.predict(X_test)
y_pred3=dt.predict(X_test)
y_pred4=rf.predict(X_test)
y_pred5=gb.predict(X_test)
```

In [66]:
```
df=pd.DataFrame({'Actual':y_test,'lr':y_pred1,'svm':y_pred2,'dt':y_pred3,'rf':y_pred4,
```

In [67]:
```
df
```

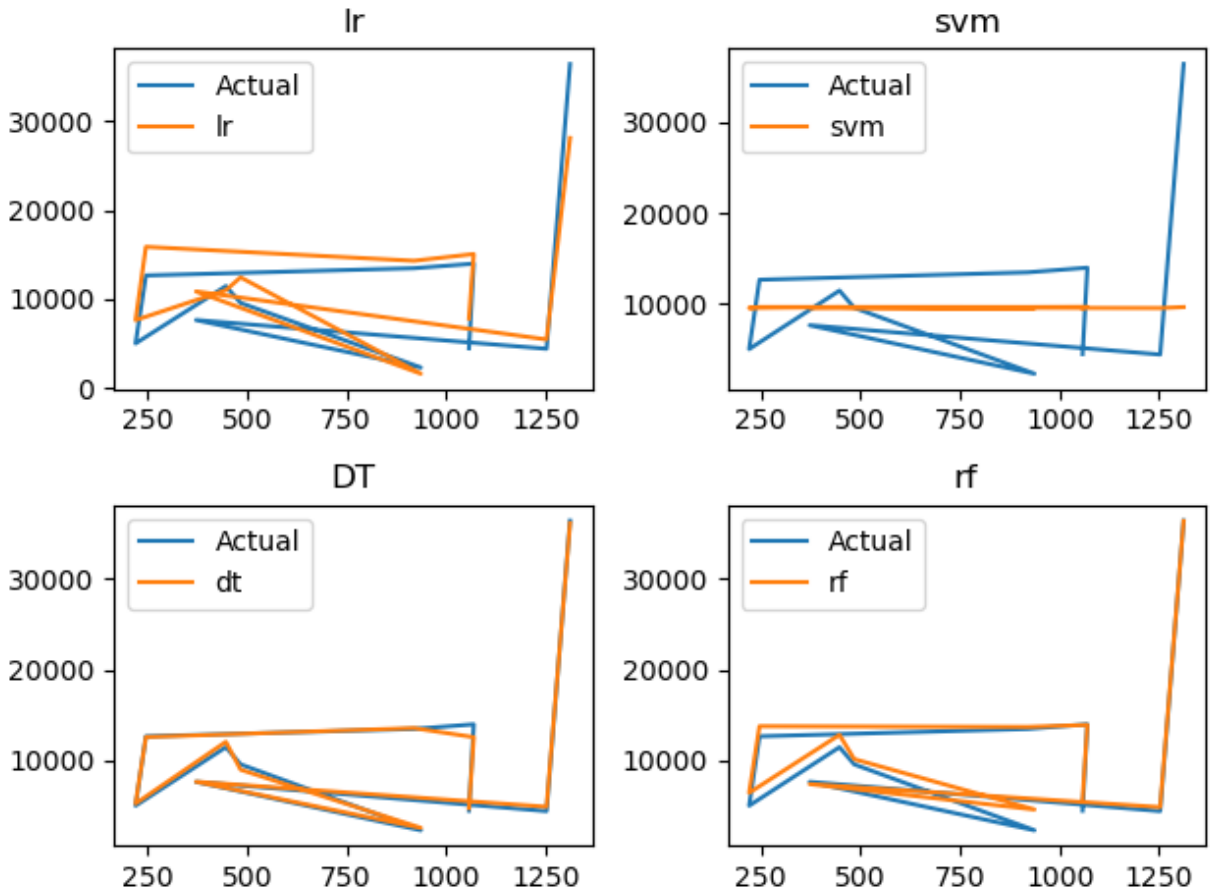
Out[67]:

	Actual	lr	svm	dt	rf	gb
1312	36397.576000	28092.188560	9641.600927	36124.57370	36354.016108	35349.307505
1253	4415.158800	5458.794661	9532.329101	4889.03680	4849.325697	6200.037031
372	7639.417450	10849.125756	9595.762809	7650.77375	7391.761100	8297.255950
937	2304.002200	1612.419697	9532.913216	2566.47070	4593.545503	4784.729408
484	9563.029000	12435.739436	9610.522892	8978.18510	10136.833597	9799.187492
...	...	...	...	...	...	...
427	7323.734819	2593.126533	9544.598929	2200.83085	6847.848580	3845.246720
1152	5630.457850	9480.653044	9553.360559	5385.33790	6689.164718	7667.078064
973	2322.621800	5784.830095	9533.556011	2498.41440	3333.339325	4274.640158
608	39241.442000	31858.452734	9662.168850	41949.24410	45005.054234	41928.346098
775	6986.697000	9949.182553	9573.067252	7256.72310	6945.506781	8318.979101

268 rows × 6 columns

In [84]:

```
plt.subplot(221)
plt.plot(df['Actual'].iloc[0:11],label='Actual')
plt.plot(df['lr'].iloc[0:11],label='lr')
plt.title('lr')
plt.legend()

plt.subplot(222)
plt.plot(df['Actual'].iloc[0:11],label='Actual')
plt.plot(df['svm'].iloc[0:11],label='svm')
plt.title('svm')
plt.legend()


plt.subplot(223)
plt.plot(df['Actual'].iloc[0:11],label='Actual')
plt.plot(df['dt'].iloc[0:11],label='dt')
plt.title('DT')
plt.legend()


plt.subplot(224)
plt.plot(df['Actual'].iloc[0:11],label='Actual')
plt.plot(df['rf'].iloc[0:11],label='rf')
plt.title('rf')
plt.legend()




plt.tight_layout()
```



In [ ]:
```
# DT is best for this dataset
```

Evaluating the algorithm

In [69]:
```
from sklearn.metrics import r2_score ,mean_squared_error,mean_absolute_error
```

In [ ]:
```
# now find r2_score
```

In [85]:
```
score1=print(r2_score(y_test,y_pred1))
score2=print(r2_score(y_test,y_pred2))
score3=print(r2_score(y_test,y_pred3))
score4=print(r2_score(y_test,y_pred4))
score5=print(r2_score(y_test,y_pred5))
```

```
0.8140764981210222
-0.042675208415232424
0.6987780814352922
0.8867850715265158
0.9120707360877552
```

In [ ]:
```
# now find mean squared error
```

In [90]:
```
m1=print(mean_squared_error(y_test,y_pred1))
m2=print(mean_squared_error(y_test,y_pred2))
m3=print(mean_squared_error(y_test,y_pred3))
m4=print(mean_squared_error(y_test,y_pred4))
m5=print(mean_squared_error(y_test,y_pred5))
```

```
24375059.121785313
136697456.7125169
39490984.19290555
14842774.297604289
11527757.30198512
```

In [ ]:
```
# now find mean absolute error
```

In [89]:
```
s1=print(mean_absolute_error(y_test,y_pred1))
s2=print(mean_absolute_error(y_test,y_pred2))
s3=print(mean_absolute_error(y_test,y_pred3))
s4=print(mean_absolute_error(y_test,y_pred4))
s5=print(mean_absolute_error(y_test,y_pred5))
```

```
3639.7393442443336
7745.843040114152
2762.425133242537
2267.3107394187186
2126.001808909794
```

Predict charges for new customer

In [101…
```
data={'age':35,'sex':1,'bmi':36.3,'children':4,'smoker':1,'region':2}
```

In [102…
```
df=pd.DataFrame(data,index=[0])
df
```

Out[102]:

	age	sex	bmi	children	smoker	region
0	35	1	36.3	4	1	2

In [103…
```
# beacause our dt is best for this data set
```

In [104…
```
new_pred=dt.predict(df)
print(new_pred)
```

```
[43753.33705]
```

save model using joblib

In [105…
```
# In earlier step we use only train train and test datset
# We have to train our model on whole dataset => accuracy increase
```

In [106…
```
dt=DecisionTreeRegressor()
dt.fit(X,y)
```

Out[106]:
```
▾ DecisionTreeRegressor
DecisionTreeRegressor()
```

In [107…
```
import joblib
```

In [108…
```
joblib.dump(dt,'model_joblib_dt')
```

Out[108]:
```
['model_joblib_dt']
```

In [109…
```
model=joblib.load('model_joblib_dt')
```

In [110…
```
model.predict(df)
```

Out[110]:
```
array([39774.2763])
```

GUI

In [112…
```
import joblib
```

In [154…
```
import tkinter as tk

def show_entry():
    p1 = float(e1.get())
    p2 = float(e2.get())
    p3 = float(e3.get())
    p4 = float(e4.get())
    p5 = float(e5.get())
    p6 = float(e6.get())

    model = joblib.load('model_joblib_dt')
    result = model.predict([[p1, p2, p3, p4, p5, p6]])

    tk.Label(master, text='Insurance Cost').grid(row=7)
    tk.Label(master, text=result).grid(row=8)


# Create a Tkinter window
master = tk.Tk()
master.title('Insurance Cost Prediction')

label = tk.Label(master, text='Insurance Cost Prediction', bg='black', fg='white')
label.grid(row=0, columnspan=2)

tk.Label(master, text='Enter Your Age').grid(row=1)
tk.Label(master, text='Male or Female[1/0]').grid(row=2)
tk.Label(master, text='Enter Your BMI value').grid(row=3)
tk.Label(master, text='Enter No of children').grid(row=4)
tk.Label(master, text='Smoker Yes/No [1/0]').grid(row=5)
tk.Label(master, text='Region [1-4]').grid(row=6)

e1 = tk.Entry(master)
e2 = tk.Entry(master)
e3 = tk.Entry(master)
e4 = tk.Entry(master)
e5 = tk.Entry(master)
e6 = tk.Entry(master)

e1.grid(row=1, column=1)
e2.grid(row=2, column=1)
e3.grid(row=3, column=1)
```

```
e4.grid(row=4, column=1)
e5.grid(row=5, column=1)
e6.grid(row=6, column=1)

tk.Button(master, text='Predict', command=show_entry).grid(row=7, columnspan=2)

# Start the Tkinter event loop
master.mainloop()
```

```
Exception in Tkinter callback
Traceback (most recent call last):
  File "C:\Users\Pratik\anaconda3\lib\tkinter\__init__.py", line 1921, in __call__
    return self.func(*args)
  File "C:\Users\Pratik\AppData\Local\Temp\ipykernel_7412\2487380643.py", line 4, in
show_entry
    p1 = float(e1.get())
ValueError: could not convert string to float: ''
```

In [ ]:

In [158…

```
pip install dash
```

```
Collecting dash
  Downloading dash-2.11.1-py3-none-any.whl (10.4 MB)
     ---------------------------------------- 10.4/10.4 MB 3.5 MB/s eta 0:00:00
Collecting ansi2html
  Downloading ansi2html-1.8.0-py3-none-any.whl (16 kB)
Requirement already satisfied: typing-extensions>=4.1.1 in c:\users\pratik\anaconda3
\lib\site-packages (from dash) (4.4.0)
Requirement already satisfied: nest-asyncio in c:\users\pratik\anaconda3\lib\site-pac
kages (from dash) (1.5.6)
Requirement already satisfied: plotly>=5.0.0 in c:\users\pratik\anaconda3\lib\site-pa
ckages (from dash) (5.9.0)
Collecting dash-core-components==2.0.0
  Downloading dash_core_components-2.0.0-py3-none-any.whl (3.8 kB)
Collecting retrying
  Downloading retrying-1.3.4-py3-none-any.whl (11 kB)
Requirement already satisfied: Werkzeug<2.3.0 in c:\users\pratik\anaconda3\lib\site-p
ackages (from dash) (2.2.2)
Collecting dash-html-components==2.0.0
  Downloading dash_html_components-2.0.0-py3-none-any.whl (4.1 kB)
Requirement already satisfied: Flask<2.3.0,>=1.0.4 in c:\users\pratik\anaconda3\lib\s
ite-packages (from dash) (2.2.2)
Requirement already satisfied: requests in c:\users\pratik\anaconda3\lib\site-package
s (from dash) (2.28.1)
Collecting dash-table==5.0.0
  Downloading dash_table-5.0.0-py3-none-any.whl (3.9 kB)
Requirement already satisfied: Jinja2>=3.0 in c:\users\pratik\anaconda3\lib\site-pack
ages (from Flask<2.3.0,>=1.0.4->dash) (3.1.2)
Requirement already satisfied: itsdangerous>=2.0 in c:\users\pratik\anaconda3\lib\sit
e-packages (from Flask<2.3.0,>=1.0.4->dash) (2.0.1)
Requirement already satisfied: click>=8.0 in c:\users\pratik\anaconda3\lib\site-packa
ges (from Flask<2.3.0,>=1.0.4->dash) (8.0.4)
Requirement already satisfied: tenacity>=6.2.0 in c:\users\pratik\anaconda3\lib\site-
packages (from plotly>=5.0.0->dash) (8.0.1)
Requirement already satisfied: MarkupSafe>=2.1.1 in c:\users\pratik\anaconda3\lib\sit
e-packages (from Werkzeug<2.3.0->dash) (2.1.1)
Requirement already satisfied: idna<4,>=2.5 in c:\users\pratik\anaconda3\lib\site-pac
kages (from requests->dash) (3.4)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\users\pratik\anaconda3\lib
\site-packages (from requests->dash) (1.26.14)
Requirement already satisfied: charset-normalizer<3,>=2 in c:\users\pratik\anaconda3
\lib\site-packages (from requests->dash) (2.0.4)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\pratik\anaconda3\lib\si
te-packages (from requests->dash) (2022.12.7)
Requirement already satisfied: six>=1.7.0 in c:\users\pratik\anaconda3\lib\site-packa
ges (from retrying->dash) (1.16.0)
Requirement already satisfied: colorama in c:\users\pratik\anaconda3\lib\site-package
s (from click>=8.0->Flask<2.3.0,>=1.0.4->dash) (0.4.6)
Installing collected packages: dash-table, dash-html-components, dash-core-component
s, retrying, ansi2html, dash
Successfully installed ansi2html-1.8.0 dash-2.11.1 dash-core-components-2.0.0 dash-ht
ml-components-2.0.0 dash-table-5.0.0 retrying-1.3.4
Note: you may need to restart the kernel to use updated packages.
```

In [ ]:

In [ ]:

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In [157…
```
# using pyqt
```

In [155…
```
pip install pyqt5
```

```
Requirement already satisfied: pyqt5 in c:\users\pratik\anaconda3\lib\site-packages
(5.15.7)Note: you may need to restart the kernel to use updated packages.

Requirement already satisfied: PyQt5-sip<13,>=12.11 in c:\users\pratik\anaconda3\lib
\site-packages (from pyqt5) (12.11.0)
```

In [156…
```
import sys
from PyQt5.QtWidgets import QApplication, QMainWindow, QLabel, QVBoxLayout, QWidget, C


class InsuranceCostPredictor(QMainWindow):
    def __init__(self):
        super().__init__()
        self.setWindowTitle('Insurance Cost Prediction')
        self.setGeometry(100, 100, 400, 300)

        self.layout = QVBoxLayout()

        self.label = QLabel('Insurance Cost Prediction', self)
        self.label.setStyleSheet("background-color: black; color: white; padding: 10px
        self.layout.addWidget(self.label)

        self.input_labels = ['Age', 'Male or Female[1/0]', 'BMI', 'No. of Children', '
        self.input_fields = []
        for label in self.input_labels:
            input_label = QLabel(label, self)
            self.layout.addWidget(input_label)

            input_field = QLineEdit(self)
            self.layout.addWidget(input_field)
            self.input_fields.append(input_field)

        self.predict_button = QPushButton('Predict', self)
        self.predict_button.clicked.connect(self.show_result)
        self.layout.addWidget(self.predict_button)

        self.result_label = QLabel('Insurance Cost:', self)
        self.layout.addWidget(self.result_label)

        self.central_widget = QWidget(self)
        self.central_widget.setLayout(self.layout)
        self.setCentralWidget(self.central_widget)

    def show_result(self):
        inputs = [float(input_field.text()) for input_field in self.input_fields]

        # Load and use the trained model for prediction
        model = joblib.load('model_joblib_dt')
        result = model.predict([inputs])
```

```
        self.result_label.setText(f'Insurance Cost: {result[0]}')


if __name__ == '__main__':
    app = QApplication(sys.argv)
    window = InsuranceCostPredictor()
    window.show()
    sys.exit(app.exec_())
```

```
C:\Users\Pratik\anaconda3\lib\site-packages\sklearn\base.py:420: UserWarning: X does
not have valid feature names, but DecisionTreeRegressor was fitted with feature names
  warnings.warn(
An exception has occurred, use %tb to see the full traceback.

SystemExit: 0
C:\Users\Pratik\anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3468: Us
erWarning: To exit: use 'exit', 'quit', or Ctrl-D.
  warn("To exit: use 'exit', 'quit', or Ctrl-D.", stacklevel=1)
```

In [ ]:

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In [ ]:

In [ ]:
```
#dash
```

In [159…
```
import dash
import dash_core_components as dcc
import dash_html_components as html
from dash.dependencies import Input, Output
import joblib

app = dash.Dash(__name__)
app.title = 'Insurance Cost Prediction'

app.layout = html.Div([
    html.H1('Insurance Cost Prediction', style={'background-color': 'black', 'color':
    html.Div([
        html.Label('Age'),
        dcc.Input(id='age', type='number', placeholder='Enter your age')
    ]),
    html.Div([
        html.Label('Male or Female [1/0]'),
        dcc.Input(id='gender', type='number', placeholder='Enter 1 for Male, 0 for Fem
    ]),
    html.Div([
        html.Label('BMI'),
        dcc.Input(id='bmi', type='number', placeholder='Enter your BMI')
    ]),
    html.Div([
        html.Label('No. of Children'),
        dcc.Input(id='children', type='number', placeholder='Enter the number of child
    ]),
    html.Div([
```

```
        html.Label('Smoker Yes/No [1/0]'),
        dcc.Input(id='smoker', type='number', placeholder='Enter 1 for Yes, 0 for No')
    ]),
    html.Div([
        html.Label('Region [1-4]'),
        dcc.Input(id='region', type='number', placeholder='Enter your region')
    ]),
    html.Button('Predict', id='predict-button', n_clicks=0),
    html.Div(id='result')
])


@app.callback(
    Output('result', 'children'),
    [Input('predict-button', 'n_clicks')],
    [Input('age', 'value'),
     Input('gender', 'value'),
     Input('bmi', 'value'),
     Input('children', 'value'),
     Input('smoker', 'value'),
     Input('region', 'value')]
)
def predict_insurance_cost(n_clicks, age, gender, bmi, children, smoker, region):
    if n_clicks > 0:
        inputs = [[age, gender, bmi, children, smoker, region]]

        # Load and use the trained model for prediction
        model = joblib.load('model_joblib_dt')
        result = model.predict(inputs)

        return f'Insurance Cost: {result[0]}'
    else:
        return ''


if __name__ == '__main__':
    app.run_server(debug=True)
```

```
C:\Users\Pratik\AppData\Local\Temp\ipykernel_7412\1741858600.py:2: UserWarning:
The dash_core_components package is deprecated. Please replace
`import dash_core_components as dcc` with `from dash import dcc`
  import dash_core_components as dcc
C:\Users\Pratik\AppData\Local\Temp\ipykernel_7412\1741858600.py:3: UserWarning:
The dash_html_components package is deprecated. Please replace
`import dash_html_components as html` with `from dash import html`
  import dash_html_components as html
```

Loading...

```
C:\Users\Pratik\anaconda3\lib\site-packages\sklearn\base.py:420: UserWarning:

X does not have valid feature names, but DecisionTreeRegressor was fitted with featur
e names
```

In [ ]: