Dataset regarding medical expenses for an insurance company.

Model used is Linear Regression and Root Mean Squared error is calculated.

Finally, accuracy of the model after scaling and encoding of data is shown.

In [139]:

```
from urllib.request import urlretrieve

expenses_url = 'https://raw.githubusercontent.com/JovianML/opendatasets/master/data/medical
```

In [140]:

```
urlretrieve(expenses_url, 'expenses.csv')
```

Out[140]:

```
('expenses.csv', <http.client.HTTPMessage at 0x2ef05f1fc40>)
```

In [141]:

```
import pandas as pd
data = pd.read_csv('expenses.csv')
```

In [142]:

```
data.shape
```

Out[142]:

```
(1338, 7)
```

In [143]:

```
data.head()
```

Out[143]:

	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 [144]:

```
data['region'].value_counts()
```

Out[144]:

```
southeast    364
southwest    325
northwest    325
northeast    324
Name: region, dtype: int64
```

In [145]:

```
data.describe()
```

Out[145]:

	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

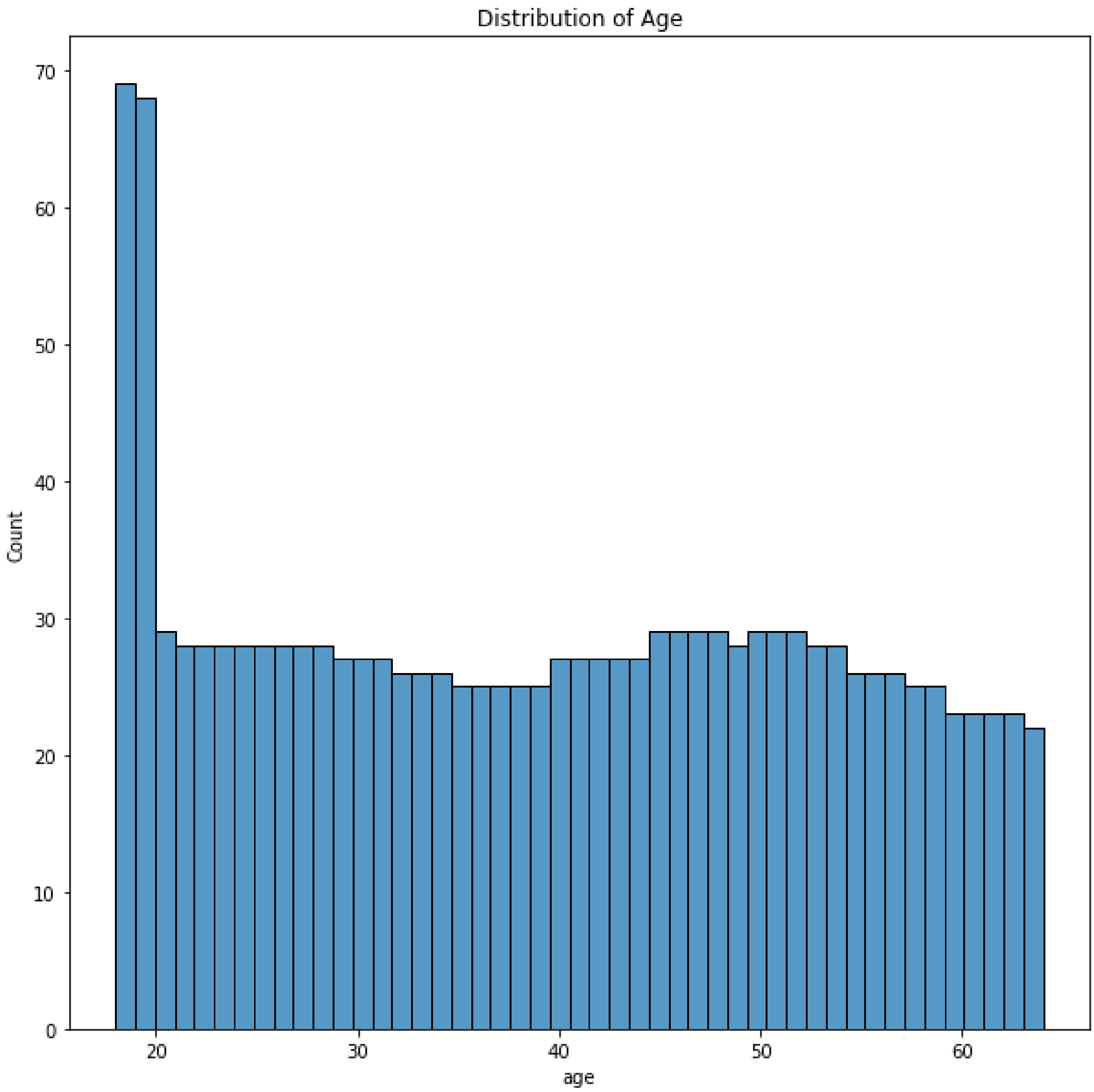
Exploring the data

In [146]:

```
import matplotlib.pyplot as plt
import seaborn as sns
```

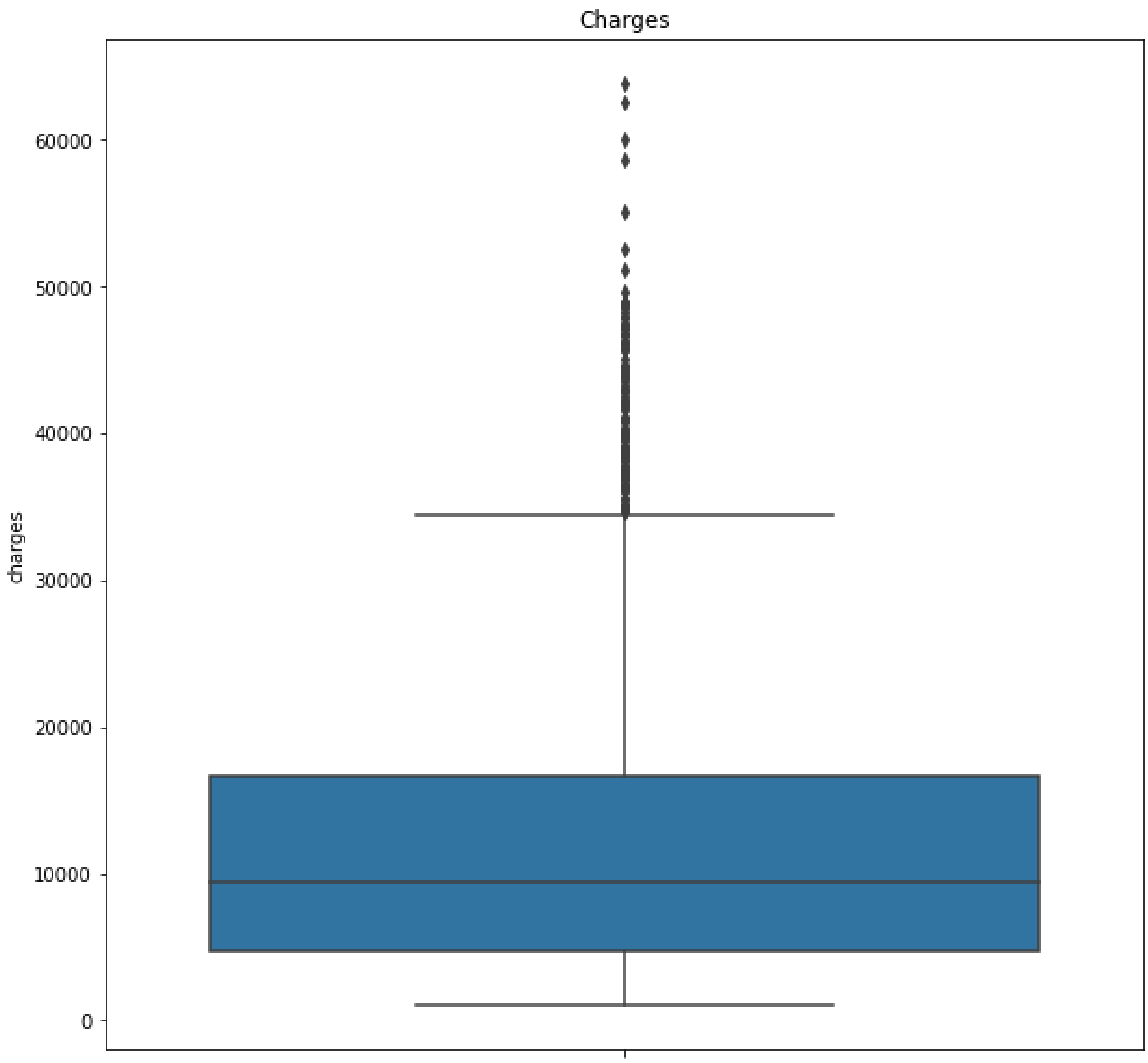
In [147]:

```
plt.figure(figsize=(10,10))

sns.histplot(data=data, x='age', bins=47)
plt.title("Distribution of Age")
plt.show()
```



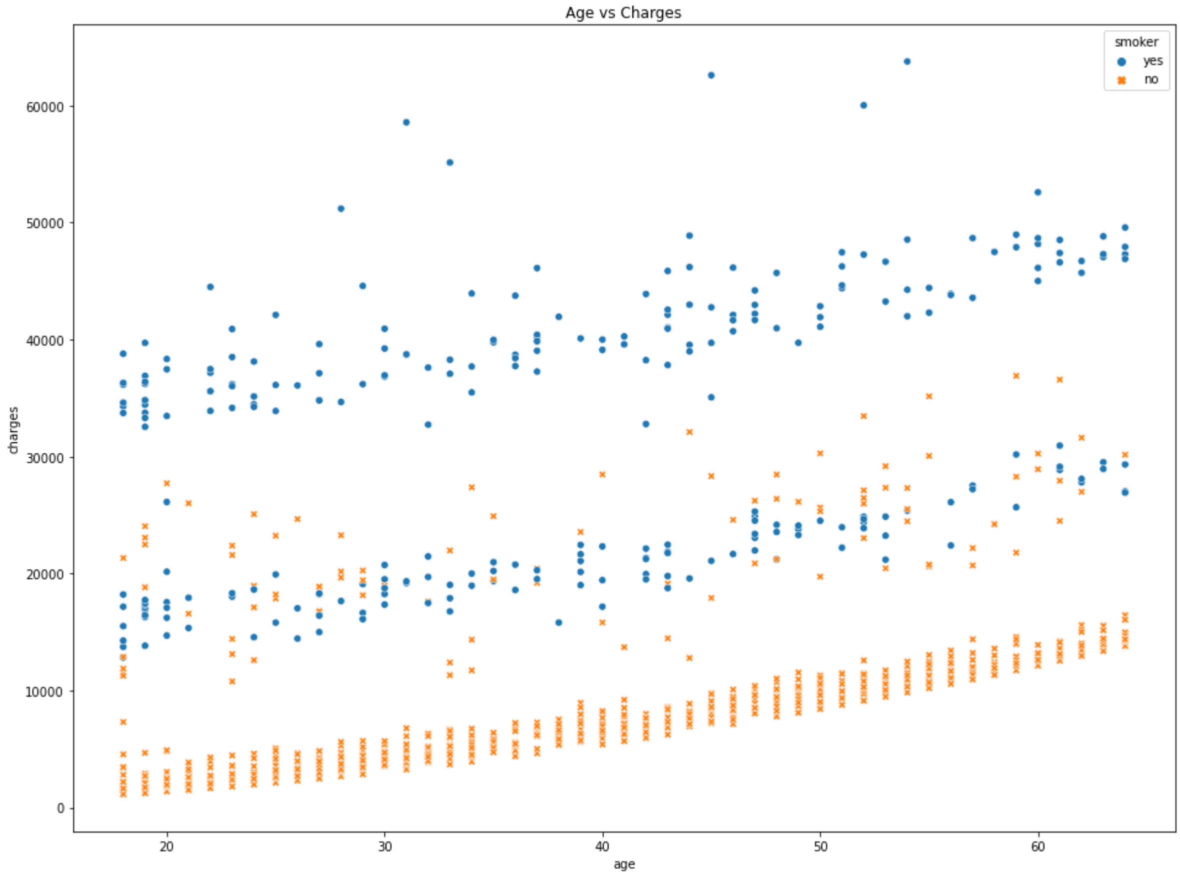
In [148]:

```
plt.figure(figsize=(10,10))
sns.boxplot(data=data, y='charges')

plt.title("Charges")
plt.show()
```



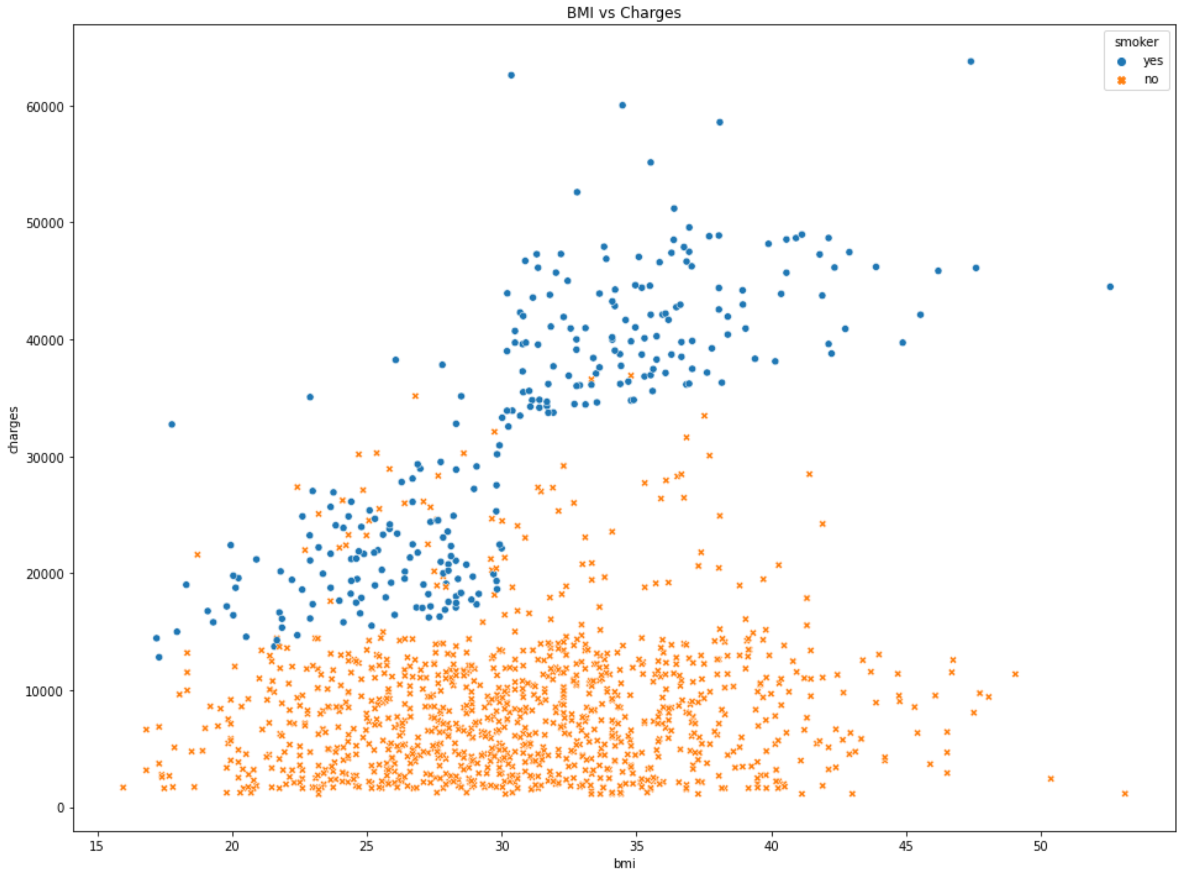
In [149]:

```
plt.figure(figsize=(16,12))
sns.scatterplot(data=data, x='age', y='charges', hue='smoker', style='smoker')

plt.title("Age vs Charges")
plt.show()
```



In [150]:

```
plt.figure(figsize=(16,12))
sns.scatterplot(data=data, x='bmi', y='charges', hue='smoker', style='smoker')

plt.title("BMI vs Charges")
plt.show()
```



In [151]:

```
data.charges.corr(data.bmi)
```

Out[151]:

0.19834096883362884

In [152]:

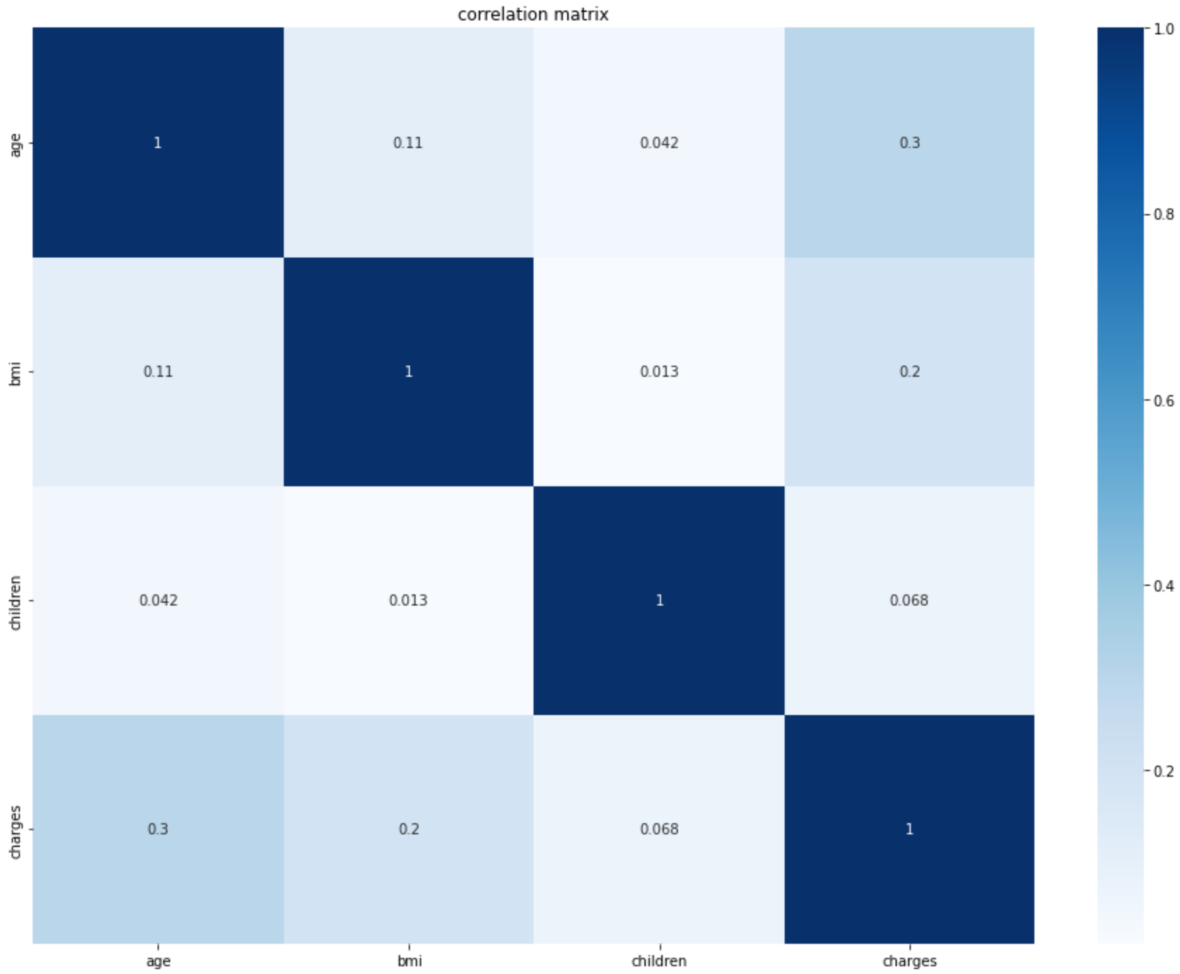
```
data.corr()
```

Out[152]:

	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 [153]:

```
plt.figure(figsize=(16,12))
sns.heatmap(data=data.corr(), annot=True, cmap='Blues')

plt.title("correlation matrix")
plt.show()
```



Dataframe with non smokers

In [154]:

```
non_smoker_data = data[data.smoker=='no']
non_smoker_data
```

Out[154]:

	age	sex	bmi	children	smoker	region	charges
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
5	31	female	25.740	0	no	southeast	3756.62160
...	...	...	...	...	...	...	...
1332	52	female	44.700	3	no	southwest	11411.68500
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

1064 rows × 7 columns

Linear regression with one feature

In [155]:

```
from sklearn.linear_model import LinearRegression
```

In [156]:

```
model = LinearRegression()
```

In [157]:

```
inputs = non_smoker_data[['age']]
targets = non_smoker_data['charges']
print(inputs.shape, targets.shape)
```

```
(1064, 1) (1064,)
```

In [158]:

```
model.fit(inputs, targets)
```

Out[158]:

```
LinearRegression()
```

Calculating Root Mean Squared Error (RMSE)

In [159]:

```
import numpy as np
def rmse(actual, predict):
    return np.sqrt(np.mean(np.square(actual-predict)))
```

In [160]:

```
predictions = model.predict(inputs)
```

In [161]:

```
rmse(targets, predictions)
```

Out[161]:

```
4662.505766636391
```

In [162]:

```
inputs = non_smoker_data[['age', 'bmi']]
inputs.shape
```

Out[162]:

```
(1064, 2)
```

In [163]:

```
model.fit(inputs, targets)
```

Out[163]:

```
LinearRegression()
```

In [164]:

```
predictions = model.predict(inputs)
```

In [165]:

```
rmse(targets, predictions)
```

Out[165]:

```
4662.312835461297
```

In [166]:

```
print("Accuracy:",model.score(inputs, targets)*100,"%")
```

```
Accuracy: 39.43672876561962 %
```

Linear regression with only one feature fails to capture the whole picture, which was expected. We move on to creating a model with all features included.

Encoding categorical values with mapping and one hot encoder

In [167]:

```
from sklearn import preprocessing
hot_encoder = preprocessing.OneHotEncoder()
```

In [168]:

```
hot_encoder.fit(data[['region']])
hot_encoder.categories_
```

Out[168]:

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

In [169]:

```
regions = hot_encoder.transform(data[['region']]).toarray()
regions
```

Out[169]:

```
array([[0., 0., 0., 1.],
       [0., 0., 1., 0.],
       [0., 0., 1., 0.],
       ...,
       [0., 0., 1., 0.],
       [0., 0., 0., 1.],
       [0., 1., 0., 0.]])
```

In [170]:

```
data[['northeast', 'northwest', 'southeast', 'southwest']] = regions
```

In [171]:

```
data.head()
```

Out[171]:

	age	sex	bmi	children	smoker	region	charges	northeast	northwest	southe
0	19	female	27.900	0	yes	southwest	16884.92400	0.0	0.0	
1	18	male	33.770	1	no	southeast	1725.55230	0.0	0.0	
2	28	male	33.000	3	no	southeast	4449.46200	0.0	0.0	
3	33	male	22.705	0	no	northwest	21984.47061	0.0	1.0	
4	32	male	28.880	0	no	northwest	3866.85520	0.0	1.0	

In [172]:

```
smokers = {'no':0, 'yes':1}
data['smoker_code'] = data.smoker.map(smokers)
data.head()
```

Out[172]:

	age	sex	bmi	children	smoker	region	charges	northeast	northwest	southe
0	19	female	27.900	0	yes	southwest	16884.92400	0.0	0.0	
1	18	male	33.770	1	no	southeast	1725.55230	0.0	0.0	
2	28	male	33.000	3	no	southeast	4449.46200	0.0	0.0	
3	33	male	22.705	0	no	northwest	21984.47061	0.0	1.0	
4	32	male	28.880	0	no	northwest	3866.85520	0.0	1.0	

In [173]:

```
gender = {'female':0, 'male':1}
data['sex_code'] = data.sex.map(gender)
data.head()
```

Out[173]:

	age	sex	bmi	children	smoker	region	charges	northeast	northwest	southe
0	19	female	27.900	0	yes	southwest	16884.92400	0.0	0.0	
1	18	male	33.770	1	no	southeast	1725.55230	0.0	0.0	
2	28	male	33.000	3	no	southeast	4449.46200	0.0	0.0	
3	33	male	22.705	0	no	northwest	21984.47061	0.0	1.0	
4	32	male	28.880	0	no	northwest	3866.85520	0.0	1.0	

In [174]:

```
inputs2, targets = data[['age','bmi','children', 'smoker_code', 'northeast', 'northwest', '
model.fit(inputs2, targets)
```

Out[174]:

```
LinearRegression()
```

In [175]:

```
predictions = model.predict(inputs2)
rmse(targets, predictions)
```

Out[175]:

```
6042.033215394106
```

In [176]:

```
data.head()
```

Out[176]:

	age	sex	bmi	children	smoker	region	charges	northeast	northwest	southe
0	19	female	27.900	0	yes	southwest	16884.92400	0.0	0.0	
1	18	male	33.770	1	no	southeast	1725.55230	0.0	0.0	
2	28	male	33.000	3	no	southeast	4449.46200	0.0	0.0	
3	33	male	22.705	0	no	northwest	21984.47061	0.0	1.0	
4	32	male	28.880	0	no	northwest	3866.85520	0.0	1.0	

Scaling numerical columns

In [177]:

```
scaler = preprocessing.StandardScaler()
columns_to_scale = ['age', 'bmi', 'children']
scaler.fit(data[columns_to_scale])
```

Out[177]:

```
StandardScaler()
```

In [178]:

```
scaled_columns = scaler.transform(data[columns_to_scale])
scaled_columns
```

Out[178]:

```
array([[-1.43876426, -0.45332   , -0.90861367],
       [-1.50996545,  0.5096211 , -0.07876719],
       [-0.79795355,  0.38330685,  1.58092576],
       ...,
       [-1.50996545,  1.0148781 , -0.90861367],
       [-1.29636188, -0.79781341, -0.90861367],
       [ 1.55168573, -0.26138796, -0.90861367]])
```

Inputs for model after scaling and encoding

In [179]:

```
encoded_columns = ['sex_code', 'smoker_code', 'northeast', 'northwest', 'southeast', 'south
categorical_data = data[encoded_columns].values
numerical_data = data[columns_to_scale].values
```

In [180]:

```
inputs2 = np.concatenate((categorical_data, numerical_data), axis=1)
targets = data.charges
```

In [181]:

```
model = LinearRegression()
```

In [182]:

```
model.fit(inputs2, targets)
```

Out[182]:

```
LinearRegression()
```

In [183]:

```
predictions = model.predict(inputs2)
```

In [184]:

```
rmse(targets, predictions)
```

Out[184]:

```
6041.679651174457
```

In [185]:

```
print("Accuracy:",model.score(inputs2, targets)*100,"%")
```

```
Accuracy: 75.09130345985207 %
```

Due to a high number of outliers in this dataset, we only achieve an accuracy of 75%, which can be improved further with optimisations