- Dataset can be found at Medical Cost Personal Datasets (https://www.kaggle.com/mirichoi0218/insurance)
- More about K-Means clustering at Linear Regression (https://scikit-learn.org/stable/modules/generated/sklearn.linear_model.LinearRegression.html)

In [1]:

```
import pandas as pd
import numpy as np

from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
```

In [2]:

```
df = pd.read_csv("insurance.csv")
df.head()
```

Out[2]:

	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

What does the dataset contain ?

age: age of primary beneficiary

sex: insurance contractor gender, female, male

bmi: Body mass index, providing an understanding of body, weights that are relatively high or low relative to height, objective index of body weight (kg / m ^ 2) using the ratio of height to weight, ideally 18.5 to 24.9

children: Number of children covered by health insurance / Number of dependents

smoker: Smoking

smoker: Smoking

region: the beneficiary's residential area in the US, northeast, southeast, southwest, northwest.

charges: Individual medical costs billed by health insurance

In [3]:

```
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 [4]:

```
df['sex'].replace({'male': 0, 'female': 1}, inplace=True)
df['smoker'].replace({'yes': 0, 'no': 1}, inplace=True)
df = pd.concat([df, pd.get_dummies(df['region'], prefix='region')], axis=1)
df.drop(columns=['region'], inplace=True)
df.head()
```

Out[4]:

	age	sex	bmi	children	smoker	charges	region_northeast	region_northwest	region_southeast	region_southwest
0	19	1	27.900	0	0	16884.92400	0	0	0	1
1	18	0	33.770	1	1	1725.55230	0	0	1	0
2	28	0	33.000	3	1	4449.46200	0	0	1	0
3	33	0	22.705	0	1	21984.47061	0	1	0	0
4	32	0	28.880	0	1	3866.85520	0	1	0	0

What is the algorithm

```
Linear regression is a supervised regression algorithm.
Linear regression is a linear approach to modelling the relationship between a scalar response and one or more
explanatory variables (also known as dependent and independent variables)
```

Advantages and Disadvantges of the algorithm

```
Advantages:
* Linear regression performs exceptionally well for linearly separable data
* Easier to implement, interpret and efficient to train
* It handles overfitting pretty well using dimensionally reduction techniques, regularization, and cross-
validation
* One more advantage is the extrapolation beyond a specific data set

Disadvantages:
* The assumption of linearity between dependent and independent variables
* It is often quite prone to noise and overfitting
* Linear regression is quite sensitive to outliers
* It is prone to multicollinearity
```

How is it performed on the dataset

In [5]:

```
df.head()
```

Out[5]:

	age	sex	bmi	children	smoker	charges	region_northeast	region_northwest	region_southeast	region_southwest
0	19	1	27.900	0	0	16884.92400	0	0	0	1
1	18	0	33.770	1	1	1725.55230	0	0	1	0
2	28	0	33.000	3	1	4449.46200	0	0	1	0
3	33	0	22.705	0	1	21984.47061	0	1	0	0
4	32	0	28.880	0	1	3866.85520	0	1	0	0

In [6]:

```
X = df.drop(columns=['charges'])
y = df[['charges']]
```

In [7]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=42, test_size=0.3)
```

In [8]:
```
ss = StandardScaler()

X_train_std = ss.fit_transform(X_train)
X_test_std = ss.transform(X_test)
```

In [9]:
```
regressor = LinearRegression()
regressor.fit(X_train_std, y_train)
```

Out[9]:
```
LinearRegression()
```

In [10]:
```
regressor.score(X_test_std, y_test) ## Accuracy score on test dataset
```

Out[10]:
```
0.769611805436901
```

In [11]:
```
X_full = ss.transform(X)
predictions = regressor.predict(X_full)
df['Prediction'] = predictions
df.head()
```

Out[11]:

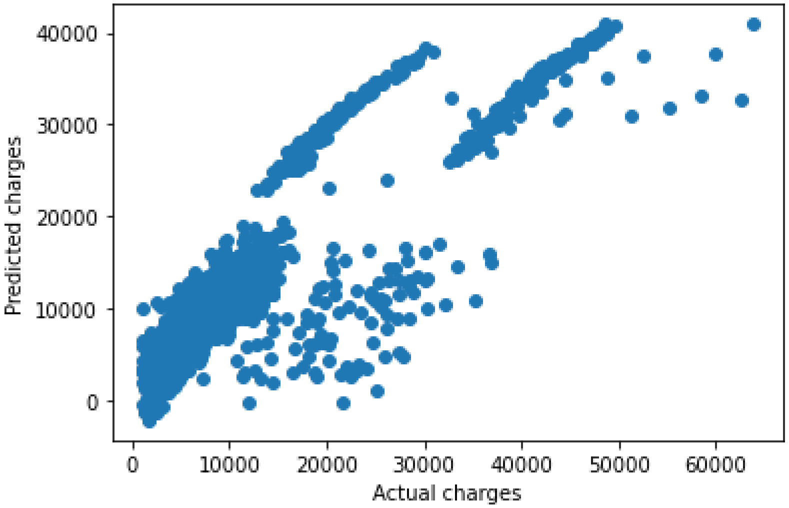
	age	sex	bmi	children	smoker	charges	region_northeast	region_northwest	region_southeast	region_southwest	Pred
0	19	1	27.900	0	0	16884.92400	0	0	0	1	25027.2
1	18	0	33.770	1	1	1725.55230	0	0	1	0	3669.9
2	28	0	33.000	3	1	4449.46200	0	0	1	0	6862.4
3	33	0	22.705	0	1	21984.47061	0	1	0	0	3788.6
4	32	0	28.880	0	1	3866.85520	0	1	0	0	5681.8

In [12]:
```
print("The accuracy score of KNN on the dataset is: {}".format(regressor.score(X_full, y)))
```

```
The accuracy score of KNN on the dataset is: 0.7506272930769431
```

In [13]:

```
import matplotlib.pyplot as plt
plt.scatter(df['charges'].values, df['Prediction'].values)
plt.xlabel("Actual charges")
plt.ylabel("Predicted charges")
plt.show();
```



Summary

- The features do not seem to be linearly dependency.
- Linear Regression is limited to linearly dependent data.
- The performance of the model could be increased by feature engineering, mapping the data to a linearly separable space.

In [ ]:

```
```