```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

from sklearn.datasets import load_boston
boston =load_boston()

data = pd.DataFrame(boston.data)

data.columns = boston.feature_names
data.head()
```

```
      CRIM    ZN  INDUS  CHAS    NOX     RM   AGE     DIS  RAD    TAX
\
0  0.00632  18.0   2.31   0.0  0.538  6.575  65.2  4.0900  1.0  296.0

1  0.02731   0.0   7.07   0.0  0.469  6.421  78.9  4.9671  2.0  242.0

2  0.02729   0.0   7.07   0.0  0.469  7.185  61.1  4.9671  2.0  242.0

3  0.03237   0.0   2.18   0.0  0.458  6.998  45.8  6.0622  3.0  222.0

4  0.06905   0.0   2.18   0.0  0.458  7.147  54.2  6.0622  3.0  222.0


   PTRATIO       B  LSTAT
0     15.3  396.90   4.98
1     17.8  396.90   9.14
2     17.8  392.83   4.03
3     18.7  394.63   2.94
4     18.7  396.90   5.33
```

```
data['PRICE'] = boston.target

data
```

```
        CRIM    ZN  INDUS  CHAS    NOX     RM   AGE     DIS  RAD
TAX  \
0    0.00632  18.0   2.31   0.0  0.538  6.575  65.2  4.0900  1.0
296.0
1    0.02731   0.0   7.07   0.0  0.469  6.421  78.9  4.9671  2.0
242.0
2    0.02729   0.0   7.07   0.0  0.469  7.185  61.1  4.9671  2.0
242.0
3    0.03237   0.0   2.18   0.0  0.458  6.998  45.8  6.0622  3.0
222.0
4    0.06905   0.0   2.18   0.0  0.458  7.147  54.2  6.0622  3.0
222.0
..       ...   ...    ...   ...    ...    ...   ...     ...  ...    ..
```

```
.
501  0.06263   0.0  11.93   0.0  0.573  6.593  69.1  2.4786  1.0
273.0
502  0.04527   0.0  11.93   0.0  0.573  6.120  76.7  2.2875  1.0
273.0
503  0.06076   0.0  11.93   0.0  0.573  6.976  91.0  2.1675  1.0
273.0
504  0.10959   0.0  11.93   0.0  0.573  6.794  89.3  2.3889  1.0
273.0
505  0.04741   0.0  11.93   0.0  0.573  6.030  80.8  2.5050  1.0
273.0
```

```
     PTRATIO       B  LSTAT  PRICE
0       15.3  396.90   4.98   24.0
1       17.8  396.90   9.14   21.6
2       17.8  392.83   4.03   34.7
3       18.7  394.63   2.94   33.4
4       18.7  396.90   5.33   36.2
..       ...     ...    ...    ...
501     21.0  391.99   9.67   22.4
502     21.0  396.90   9.08   20.6
503     21.0  396.90   5.64   23.9
504     21.0  393.45   6.48   22.0
505     21.0  396.90   7.88   11.9

[506 rows x 14 columns]
```

```
data.isnull().sum()
```

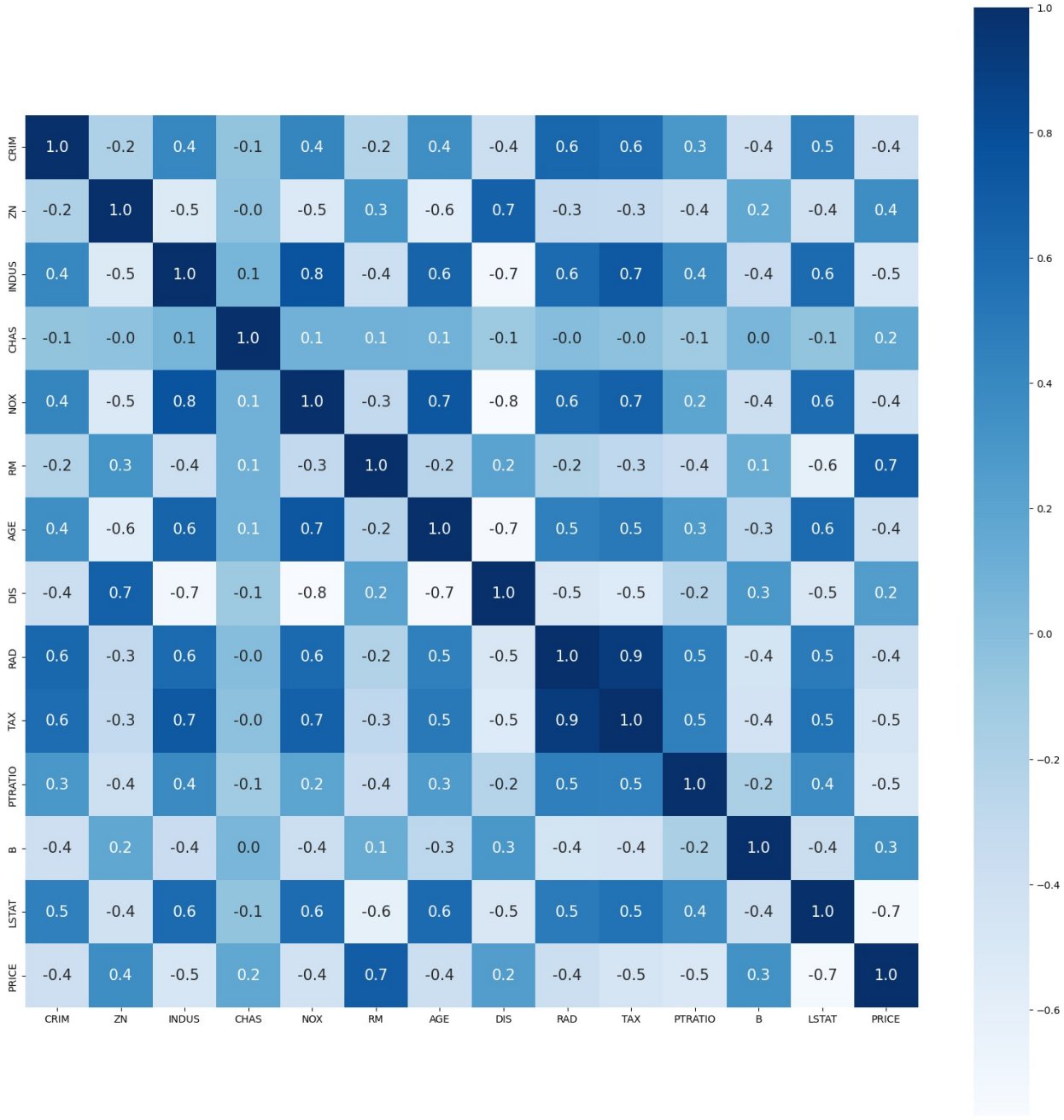
```
CRIM       0
ZN         0
INDUS      0
CHAS       0
NOX        0
RM         0
AGE        0
DIS        0
RAD        0
TAX        0
PTRATIO    0
B          0
LSTAT      0
PRICE      0
dtype: int64
```

```
corr = data.corr()
corr.shape
```

```
(14, 14)
```

```
plt.figure(figsize=(20,20))
sns.heatmap(corr, cbar=True, square= True, fm='.1f', annot=True,
annot_kws={'size':15}, cmap='Blues')

plt.show()
```




```
x = data.drop(['PRICE'], axis = 1)
y = data['PRICE']
```

```
from sklearn.model_selection import train_test_split
xtrain, xtest, ytrain, ytest =train_test_split(x, y, test_size
=0.2,random_state = 0)

import sklearn
from sklearn.linear_model import LinearRegression
lm = LinearRegression()
# Train the model using the training sets
model=lm.fit(xtrain,ytrain)

xtrain
```

```
         CRIM    ZN  INDUS  CHAS    NOX     RM   AGE     DIS   RAD
TAX  \
220   0.35809   0.0   6.20   1.0  0.507  6.951  88.5  2.8617   8.0
307.0
71    0.15876   0.0  10.81   0.0  0.413  5.961  17.5  5.2873   4.0
305.0
240   0.11329  30.0   4.93   0.0  0.428  6.897  54.3  6.3361   6.0
300.0
6     0.08829  12.5   7.87   0.0  0.524  6.012  66.6  5.5605   5.0
311.0
417  25.94060   0.0  18.10   0.0  0.679  5.304  89.1  1.6475  24.0
666.0
..        ...   ...    ...   ...    ...    ...   ...     ...   ...
...
323   0.28392   0.0   7.38   0.0  0.493  5.708  74.3  4.7211   5.0
287.0
192   0.08664  45.0   3.44   0.0  0.437  7.178  26.3  6.4798   5.0
398.0
117   0.15098   0.0  10.01   0.0  0.547  6.021  82.6  2.7474   6.0
432.0
47    0.22927   0.0   6.91   0.0  0.448  6.030  85.5  5.6894   3.0
233.0
172   0.13914   0.0   4.05   0.0  0.510  5.572  88.5  2.5961   5.0
296.0

     PTRATIO       B  LSTAT
220     17.4  391.70   9.71
71      19.2  376.94   9.88
240     16.6  391.25  11.38
6       15.2  395.60  12.43
417     20.2  127.36  26.64
..       ...     ...    ...
323     19.6  391.13  11.74
192     15.2  390.49   2.87
117     17.8  394.51  10.30
47      17.9  392.74  18.80
172     16.6  396.90  14.69
```

```
[404 rows x 13 columns]
```

```
ytrain_pred=lm.predict(xtrain)
ytest_pred=lm.predict(xtest)
```

```
testdata=[[0.00632,18.0,2.31,0.0,0.538,6.575,65.2,4.0900,1.0,296.0,15.
3,396.90,4.98]]
```

```
test_pred = lm.predict(testdata)
test_pred
```

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\base.py:450:
UserWarning: X does not have valid feature names, but LinearRegression
was fitted with feature names
  warnings.warn(
```

```
array([30.49949836])
```

```
df1=pd.DataFrame(ytrain_pred,ytrain)
df2=pd.DataFrame(ytest_pred,ytest)
df1
```

```
                0
PRICE
26.7   32.556927
21.7   21.927095
22.0   27.543826
22.9   23.603188
10.4    6.571910
...          ...
18.5   19.494951
36.4   33.326364
19.2   23.796208
16.6   18.458353
23.1   23.249181
```

```
[404 rows x 1 columns]
```

```
from sklearn.metrics import mean_squared_error, r2_score
mse = mean_squared_error(ytest, ytest_pred)
print('MSE on test data:',mse)
mse1 = mean_squared_error(ytrain_pred, ytrain)
print('MSE on training data:',mse1)
```

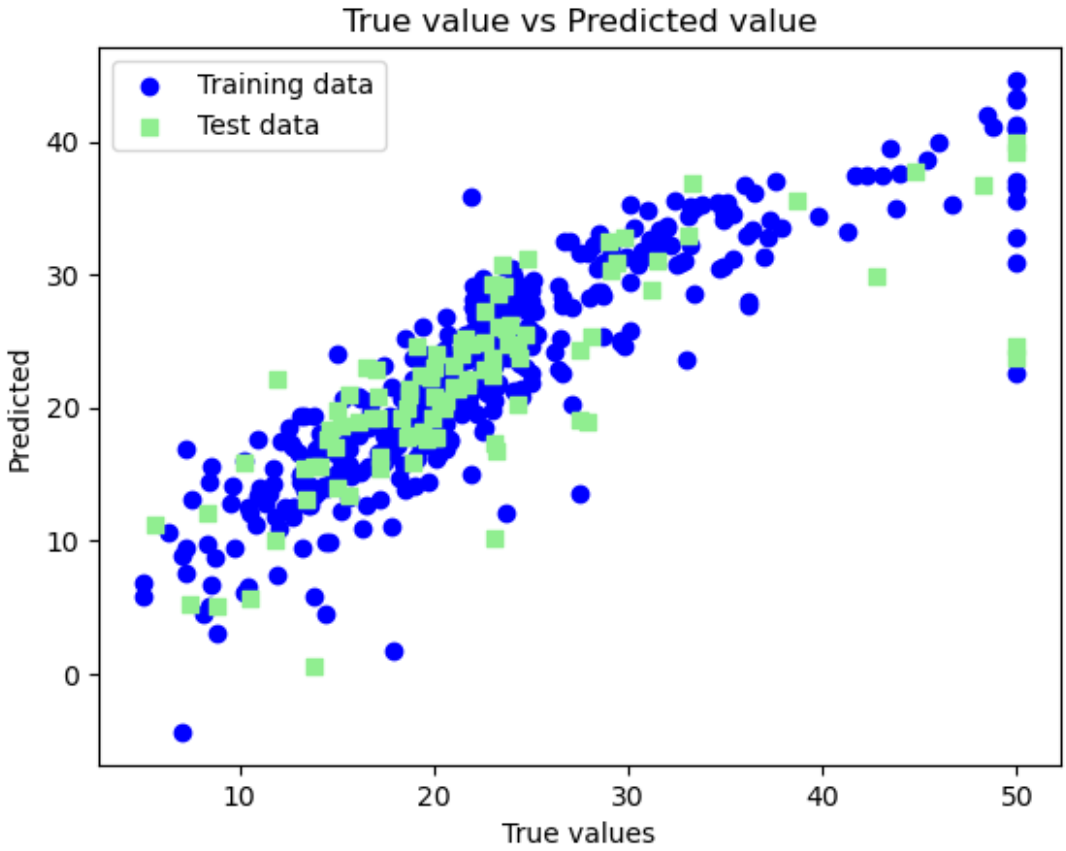
```
MSE on test data: 33.44897999767653
MSE on training data: 19.326470203585725
```

```
#from sklearn.metrics import mean_squared_error
#def linear_metrics():
r2 = lm.score(xtest, ytest)
rmse = (np.sqrt(mean_squared_error(ytest, ytest_pred)))
```

```
print('r-squared: {}' .format(r2))
print('----------------------------------------')
print('root mean squared error: {}'.format(rmse))
```

```
r-squared: 0.5892223849182507
----------------------------------------
root mean squared error: 5.783509315085135
```

```
#plotting the linear regression model
plt.scatter(ytrain ,ytrain_pred,c='blue',marker='o',label='Training
data')
plt.scatter(ytest,ytest_pred ,c='lightgreen',marker='s',label='Test
data')
plt.xlabel('True values')
plt.ylabel('Predicted')
plt.title("True value vs Predicted value")
plt.legend(loc= 'upper left') #plt.hlines(y=0,xmin=0,xmax=50)
plt.plot()
plt.show()
```




```
testdata=[[0.00632,18.0,2.31,0.0,0.538,6.575,65.2,4.0900,1.0,296.0,15.
3,396.90,4.98]]
```

```
test_pred = lm.predict(testdata)
test_pred
```

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\base.py:450:
UserWarning: X does not have valid feature names, but LinearRegression
was fitted with feature names
  warnings.warn(

array([30.49949836])
```