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

boston = pd.read_csv("/content/Boston.csv")

# Printing first 5 records of the dataset
print(dataset.head(5))
```

```
   Unnamed: 0     crim    zn  indus  chas    nox     rm   age     dis  rad  \
0           1  0.00632  18.0   2.31     0  0.538  6.575  65.2  4.0900    1
1           2  0.02731   0.0   7.07     0  0.469  6.421  78.9  4.9671    2
2           3  0.02729   0.0   7.07     0  0.469  7.185  61.1  4.9671    2
3           4  0.03237   0.0   2.18     0  0.458  6.998  45.8  6.0622    3
4           5  0.06905   0.0   2.18     0  0.458  7.147  54.2  6.0622    3

   tax  ptratio   black  lstat  medv
0  296     15.3  396.90   4.98  24.0
1  242     17.8  396.90   9.14  21.6
2  242     17.8  392.83   4.03  34.7
3  222     18.7  394.63   2.94  33.4
4  222     18.7  396.90   5.33  36.2
```

```
boston.shape
```

```
(506, 15)
```

```
boston.columns
```

```
Index(['Unnamed: 0', 'crim', 'zn', 'indus', 'chas', 'nox', 'rm', 'age', 'dis',
       'rad', 'tax', 'ptratio', 'black', 'lstat', 'medv'],
      dtype='object')
```

```
data = pd.DataFrame(boston)
data.head(10)
```

	Unnamed: 0	crim	zn	indus	chas	nox	rm	age	dis	rad	tax	ptratio	bl
0	1	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296	15.3	396
1	2	0.02731	0.0	7.07	0	0.469	6.421	78.9	4.9671	2	242	17.8	396
2	3	0.02729	0.0	7.07	0	0.469	7.185	61.1	4.9671	2	242	17.8	392
3	4	0.03237	0.0	2.18	0	0.458	6.998	45.8	6.0622	3	222	18.7	394
4	5	0.06905	0.0	2.18	0	0.458	7.147	54.2	6.0622	3	222	18.7	396
5	6	0.02985	0.0	2.18	0	0.458	6.430	58.7	6.0622	3	222	18.7	394
6	7	0.08829	12.5	7.87	0	0.524	6.012	66.6	5.5605	5	311	15.2	395
7	8	0.14455	12.5	7.87	0	0.524	6.172	96.1	5.9505	5	311	15.2	396
8	9	0.21124	12.5	7.87	0	0.524	5.631	100.0	6.0821	5	311	15.2	386

```
data.describe()
```

	zn	indus	chas	nox	rm	age	dis	rad
	6.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000
	1.363636	11.136779	0.069170	0.554695	6.284634	68.574901	3.795043	9.549407
	3.322453	6.860353	0.253994	0.115878	0.702617	28.148861	2.105710	8.707259

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 506 entries, 0 to 505
Data columns (total 15 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   Unnamed: 0  506 non-null    int64  
 1   crim        506 non-null    float64
 2   zn          506 non-null    float64
 3   indus       506 non-null    float64
 4   chas        506 non-null    int64  
 5   nox         506 non-null    float64
 6   rm          506 non-null    float64
 7   age         506 non-null    float64
 8   dis         506 non-null    float64
 9   rad         506 non-null    int64  
 10  tax         506 non-null    int64  
 11  ptratio     506 non-null    float64
 12  black       506 non-null    float64
 13  lstat       506 non-null    float64
 14  medv        506 non-null    float64
dtypes: float64(11), int64(4)
memory usage: 59.4 KB
```

```
# Input Data
x = boston.drop('medv', axis=1)  # Assuming 'medv' is the target variable

# Output Data
y = boston['medv']


# splitting data to training and testing dataset.

#from sklearn.cross_validation import train_test_split
#the submodule cross_validation is renamed and deprecated to model_selection
from sklearn.model_selection import train_test_split

xtrain, xtest, ytrain, ytest = train_test_split(x, y, test_size =0.2,
                                                random_state = 0)

print("xtrain shape : ", xtrain.shape)
print("xtest shape : ", xtest.shape)
print("ytrain shape : ", ytrain.shape)
print("ytest shape : ", ytest.shape)
```

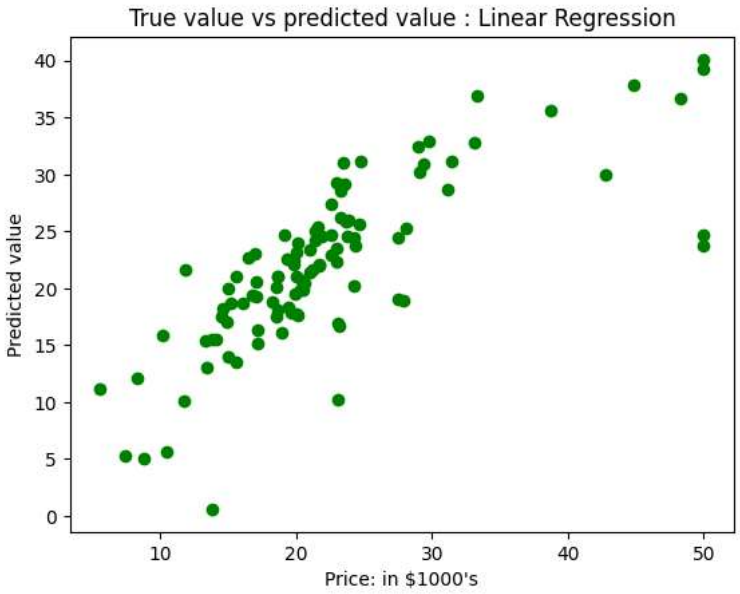
```
xtrain shape :  (404, 14)
xtest shape :  (102, 14)
ytrain shape :  (404,)
ytest shape :  (102,)
```

```
# Fitting Multi Linear regression model to training model
from sklearn.linear_model import LinearRegression
regressor = LinearRegression()
regressor.fit(xtrain, ytrain)

# predicting the test set results
y_pred = regressor.predict(xtest)



# Plotting Scatter graph to show the prediction
# results - 'ytrue' value vs 'y_pred' value
plt.scatter(ytest, y_pred, c = 'green')
plt.xlabel("Price: in $1000's")
plt.ylabel("Predicted value")
plt.title("True value vs predicted value : Linear Regression")
plt.show()
```




```
from sklearn.metrics import mean_squared_error, mean_absolute_error
mse = mean_squared_error(ytest, y_pred)
mae = mean_absolute_error(ytest,y_pred)
print("Mean Square Error : ", mse)
print("Mean Absolute Error : ", mae)
```

```
Mean Square Error :  33.266961459239106
Mean Absolute Error :  3.838476893830883
```

```
from sklearn import svm
from sklearn.svm import SVC
from sklearn.metrics import mean_absolute_percentage_error

model_SVR = svm.SVR()
model_SVR.fit(X_train,Y_train)
Y_pred = model_SVR.predict(X_valid)

print(mean_absolute_percentage_error(Y_valid, Y_pred))
```

```
0.1870512931870423
```

```
from sklearn.ensemble import RandomForestRegressor

model_RFR = RandomForestRegressor(n_estimators=10)
model_RFR.fit(X_train, Y_train)
Y_pred = model_RFR.predict(X_valid)

mean_absolute_percentage_error(Y_valid, Y_pred)
```

```
0.1871898894607579
```

```
from sklearn.linear_model import LinearRegression

model_LR = LinearRegression()
model_LR.fit(X_train, Y_train)
Y_pred = model_LR.predict(X_valid)

print(mean_absolute_percentage_error(Y_valid, Y_pred))
```

```
0.18741683841599854
```

```
!pip3 install catboost
```

```
Collecting catboost
  Downloading catboost-1.2.2-cp310-cp310-manylinux2014_x86_64.whl (98.7 MB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 98.7/98.7 MB 9.4 MB/s eta 0:00:00
Requirement already satisfied: graphviz in /usr/local/lib/python3.10/dist-packages (from catboost) (0.20.1)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.10/dist-packages (from catboost) (3.7.1)
Requirement already satisfied: numpy>=1.16.0 in /usr/local/lib/python3.10/dist-packages (from catboost) (1.23.5)
Requirement already satisfied: pandas>=0.24 in /usr/local/lib/python3.10/dist-packages (from catboost) (1.5.3)
Requirement already satisfied: scipy in /usr/local/lib/python3.10/dist-packages (from catboost) (1.11.3)
Requirement already satisfied: plotly in /usr/local/lib/python3.10/dist-packages (from catboost) (5.15.0)
Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages (from catboost) (1.16.0)
Requirement already satisfied: python-dateutil>=2.8.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=0.24->catboost) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=0.24->catboost) (2023.3.post1)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib->catboost) (1.1.1)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib->catboost) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib->catboost) (4.43.1)
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib->catboost) (1.4.5)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib->catboost) (23.2)
Requirement already satisfied: pillow>=6.2.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib->catboost) (9.4.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib->catboost) (3.1.1)
Requirement already satisfied: tenacity>=6.2.0 in /usr/local/lib/python3.10/dist-packages (from plotly->catboost) (8.2.3)
Installing collected packages: catboost
Successfully installed catboost-1.2.2
```

```
# This code is contributed by @amartajisce
from catboost import CatBoostRegressor
cb_model = CatBoostRegressor()
cb_model.fit(X_train, Y_train)
preds = cb_model.predict(X_valid)
from sklearn.metrics import r2_score
cb_r2_score=r2_score(Y_valid, preds)
cb_r2_score
```

```
990:    learn: 24503.8823626    total: 2.01s    remaining: 18.3ms
991:    learn: 24503.6610596    total: 2.01s    remaining: 16.2ms
992:    learn: 24502.7457525    total: 2.01s    remaining: 14.2ms
993:    learn: 24490.1166911    total: 2.02s    remaining: 12.2ms
994:    learn: 24488.5023143    total: 2.02s    remaining: 10.1ms
995:    learn: 24468.9731701    total: 2.02s    remaining: 8.11ms
996:    learn: 24459.0497225    total: 2.02s    remaining: 6.08ms
997:    learn: 24458.7284279    total: 2.02s    remaining: 4.05ms
998:    learn: 24448.9981948    total: 2.02s    remaining: 2.03ms
999:    learn: 24440.7422679    total: 2.03s    remaining: 0us
0.38351169878113034
```