In [1]:
```
ASSIGNMENT NO:4

AIM:
1. Linear Regression : Univariate and Multivariate
2. Least Square Method for Linear Regression
3. Measuring Performance of Linear Regression
4. Example of Linear Regression
5. Training data set and Testing data set
```

In [ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

In [5]:
```
from sklearn.datasets import fetch_california_housing

california = fetch_california_housing()
x = california.data
y = california.target
```

In [6]:
```
1 california
```

Out[6]:
```
{'data': array([[   8.3252    ,   41.        ,    6.98412698, ...,    2.55555556,
           37.88      , -122.23      ],
        [   8.3014    ,   21.        ,    6.23813708, ...,    2.10984183,
           37.86      , -122.22      ],
        [   7.2574    ,   52.        ,    8.28813559, ...,    2.80225989,
           37.85      , -122.24      ],
        ...,
        [   1.7       ,   17.        ,    5.20554273, ...,    2.3256351 ,
           39.43      , -121.22      ],
        [   1.8672    ,   18.        ,    5.32951289, ...,    2.12320917,
           39.43      , -121.32      ],
        [   2.3886    ,   16.        ,    5.25471698, ...,    2.61698113,
           39.37      , -121.24      ]]),
 'target': array([4.526, 3.585, 3.521, ..., 0.923, 0.847, 0.894]),
 'frame': None,
 'target_names': ['MedHouseVal'],
 'feature_names': ['MedInc',
  'HouseAge',
  'AveRooms',
  'AveBedrms',
  'Population',
  'AveOccup',
  'Latitude',
  'Longitude'],
 'DESCR': '.. _california_housing_dataset:\n\nCalifornia Housing dataset\n--------------
--------------\n\n**Data Set Characteristics:**\n\n    :Number of Instances: 20640\n\n
:Number of Attributes: 8 numeric, predictive attributes and the target\n\n    :Attribu
te Information:\n        - MedInc        median income in block group\n        - House
Age      median house age in block group\n        - AveRooms      average number of ro
oms per household\n        - AveBedrms     average number of bedrooms per household\n
- Population    block group population\n        - AveOccup      average number of hous
ehold members\n        - Latitude      block group latitude\n        - Longitude     b
lock group longitude\n\n    :Missing Attribute Values: None\n\nThis dataset was obtain
ed from the StatLib repository.\nhttps://www.dcc.fc.up.pt/~ltorgo/Regression/cal_housi
ng.html\n\nThe target variable is the median house value for California districts,\nex
pressed in hundreds of thousands of dollars ($100,000).\n\nThis dataset was derived fr
om the 1990 U.S. census, using one row per census\nblock group. A block group is the s
mallest geographical unit for which the U.S.\nCensus Bureau publishes sample data (a b
lock group typically has a population\nof 600 to 3,000 people).\n\nA household is a gr
oup of people residing within a home. Since the average\nnumber of rooms and bedrooms
in this dataset are provided per household, these\ncolumns may take surprisingly large
values for block groups with few households\nand many empty houses, such as vacation r
esorts.\n\nIt can be downloaded/loaded using the\n:func:`sklearn.datasets.fetch_califo
rnia_housing` function.\n\n.. topic:: References\n\n    - Pace, R. Kelley and Ronald B
arry, Sparse Spatial Autoregressions,\n      Statistics and Probability Letters, 33 (1
997) 291-297\n'}
```

In [8]:
```
1 data = pd.DataFrame(california.data)
```

In [10]:
```
1 data.columns = california.feature_names
2 data.head()
```

Out[10]:

	MedInc	HouseAge	AveRooms	AveBedrms	Population	AveOccup	Latitude	Longitude
0	8.3252	41.0	6.984127	1.023810	322.0	2.555556	37.88	-122.23
1	8.3014	21.0	6.238137	0.971880	2401.0	2.109842	37.86	-122.22
2	7.2574	52.0	8.288136	1.073446	496.0	2.802260	37.85	-122.24
3	5.6431	52.0	5.817352	1.073059	558.0	2.547945	37.85	-122.25
4	3.8462	52.0	6.281853	1.081081	565.0	2.181467	37.85	-122.25

In [11]:
```
data['PRICE'] = california.target
```

In [12]:
```
data.isnull().sum()
```

Out[12]:
```
MedInc        0
HouseAge      0
AveRooms      0
AveBedrms     0
Population    0
AveOccup      0
Latitude      0
Longitude     0
PRICE         0
dtype: int64
```

In [13]:
```
x = data.drop(['PRICE'], axis = 1)
y = data['PRICE']
```

In [15]:
```
from sklearn.model_selection import train_test_split
xtrain, xtest, ytrain, ytest = train_test_split(x, y, test_size=0.2, random_state=0
```

In [16]:
```
import sklearn
from sklearn.linear_model import LinearRegression
lm = LinearRegression()
model=lm.fit(xtrain, ytrain)
```

In [17]:
```
ytrain_pred = lm.predict(xtrain)
ytest_pred = lm.predict(xtest)
```

In [18]:
```
df=pd.DataFrame(ytrain_pred,ytrain)
df=pd.DataFrame(ytest_pred,ytest)

```

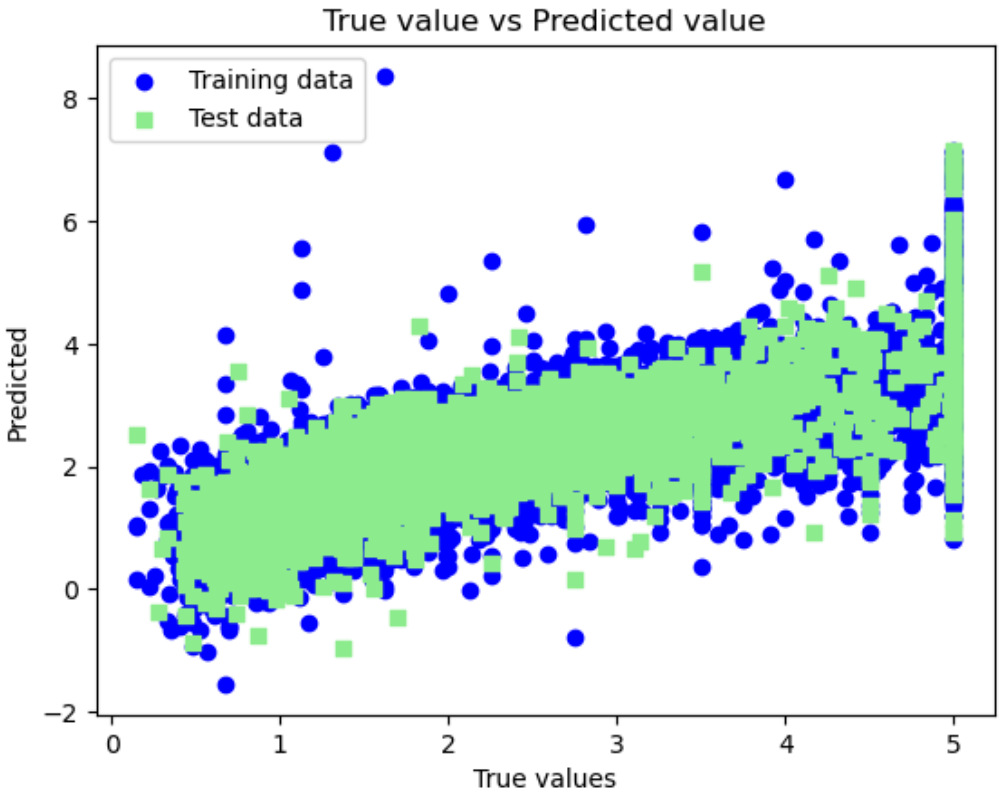
In [20]:
```
from sklearn.metrics import mean_squared_error, r2_score
mse = mean_squared_error(ytest, ytest_pred)
print(mse)
mse = mean_squared_error(ytrain_pred,ytrain)
print(mse)
```

```
0.5289841670367221
0.5234413607125449
```

In [21]:
```
mse = mean_squared_error(ytest, ytest_pred)
print(mse)
```

```
0.5289841670367221
```

In [23]:
```
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.plot()
plt.show()
```



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```
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```