In [1]:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from prettytable import PrettyTable
from sklearn.linear_model import SGDRegressor
from sklearn import preprocessing
from sklearn.metrics import mean_squared_error
from numpy import random
from sklearn.model_selection import train_test_split
print("DONE")
```

```
DONE
```

In [2]:

```
from sklearn.datasets import load_boston
boston = load_boston()
```

In [3]:

```
print(boston.data.shape)
```

```
(506, 13)
```

In [4]:

```
print(boston.feature_names)
```

```
['CRIM' 'ZN' 'INDUS' 'CHAS' 'NOX' 'RM' 'AGE' 'DIS' 'RAD' 'TAX' 'PTRATIO'
 'B' 'LSTAT']
```

In [5]:

```
print(boston.DESCR)
```

```
.. _boston_dataset:

Boston house prices dataset
---------------------------

**Data Set Characteristics:**

    :Number of Instances: 506

    :Number of Attributes: 13 numeric/categorical predictive. Median Value
(attribute 14) is usually the target.

    :Attribute Information (in order):
        - CRIM     per capita crime rate by town
        - ZN       proportion of residential land zoned for lots over 25,0
00 sq.ft.
        - INDUS    proportion of non-retail business acres per town
        - CHAS     Charles River dummy variable (= 1 if tract bounds rive
r; 0 otherwise)
        - NOX      nitric oxides concentration (parts per 10 million)
        - RM       average number of rooms per dwelling
        - AGE      proportion of owner-occupied units built prior to 1940
        - DIS      weighted distances to five Boston employment centres
        - RAD      index of accessibility to radial highways
        - TAX      full-value property-tax rate per $10,000
        - PTRATIO  pupil-teacher ratio by town
        - B        1000(Bk - 0.63)^2 where Bk is the proportion of blacks
by town
        - LSTAT    % lower status of the population
        - MEDV     Median value of owner-occupied homes in $1000's

    :Missing Attribute Values: None

    :Creator: Harrison, D. and Rubinfeld, D.L.

This is a copy of UCI ML housing dataset.
https://archive.ics.uci.edu/ml/machine-learning-databases/housing/


This dataset was taken from the StatLib library which is maintained at Car
negie Mellon University.

The Boston house-price data of Harrison, D. and Rubinfeld, D.L. 'Hedonic
prices and the demand for clean air', J. Environ. Economics & Management,
vol.5, 81-102, 1978.   Used in Belsley, Kuh & Welsch, 'Regression diagnost
ics
...', Wiley, 1980.   N.B. Various transformations are used in the table on
pages 244-261 of the latter.

The Boston house-price data has been used in many machine learning papers
that address regression
problems.

.. topic:: References

   - Belsley, Kuh & Welsch, 'Regression diagnostics: Identifying Influenti
al Data and Sources of Collinearity', Wiley, 1980. 244-261.
   - Quinlan,R. (1993). Combining Instance-Based and Model-Based Learning.
In Proceedings on the Tenth International Conference of Machine Learning,
236-243, University of Massachusetts, Amherst. Morgan Kaufmann.
```

In [6]:

```
from sklearn.datasets import load_boston
X = load_boston().data
Y = load_boston().target
df=pd.DataFrame(X)
```

In [7]:

```
print(df.shape)
```

```
(506, 13)
```

In [8]:

```
#some intuition
df[13]=df[10]//df[12]  #here we set a column 13 such that df[13]=Boston_data['Medv']//B
oston_data['B']
X=df.to_numpy()
df.head()
```

Out[8]:

	0	1	2	3	4	5	6	7	8	9	10	11	12	13
0	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	3.0
1	0.02731	0.0	7.07	0.0	0.469	6.421	78.9	4.9671	2.0	242.0	17.8	396.90	9.14	1.0
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2.0	242.0	17.8	392.83	4.03	4.0
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622	3.0	222.0	18.7	394.63	2.94	6.0
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3.0	222.0	18.7	396.90	5.33	3.0

In [9]:

```
import sklearn
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size = 0.33, random_stat
e = 5)
print(X_train.shape)
print(X_test.shape)
print(Y_train.shape)
print(Y_test.shape)

scaler = preprocessing.StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test=scaler.transform(X_test)

df_train=pd.DataFrame(X_train)
df_train['price']=Y_train

x_test=np.array(X_test)
y_test=np.array(Y_test)
```

```
(339, 14)
(167, 14)
(339,)
(167,)
```

In [10]:

```
W,B,iteration,lr_rate,k=np.zeros(shape=(1,14)),0,1000,0.01,10 #intialise W and B to zer
o

while iteration>=0:
    w,b,temp_vectors,temp_intercept=W,B,np.zeros(shape=(1,14)),0
    data=df_train.sample(25) #sampling random k=batch size=10 data
    x=np.array(data.drop('price',axis=1))
    y=np.array(data['price'])

    for i in range(k):
        temp_vectors+=(-2)*x[i]*(y[i]-(np.dot(w,x[i])+b))#partial differentiation wrt w
dl/dw=1/k(-2x)*(y-wTx-b)
        temp_intercept+=(-2)*(y[i]-(np.dot(w,x[i])+b))#partial differentiation wrt b d
l/db=1/k(-2)*(y-wTx-b)

    W=(w-lr_rate*(temp_vectors)/k)
    B=(b-lr_rate*(temp_intercept)/k)

    iteration-=1
```

In [11]:

```
print(W)
print(B)
```

```
[[-1.4270414   0.11875003 -0.53426839  0.20755808 -1.57798136  2.41321929
   0.19504314 -2.39328922  2.26165059 -1.18779472 -2.73551125  0.98991381
  -1.62114869  3.04083869]]
[22.50205285]
```

In [12]:

```
y_pred=[]
for i in range(len(x_test)):
    y=np.asscalar(np.dot(W,x_test[i])+B)
    y_pred.append(y)
```

In [13]:

```
MSE_lr=mean_squared_error(y_test,y_pred)
print('mean squared error =',MSE_lr)
```

```
mean squared error = 21.60419170779092
```

In [14]:

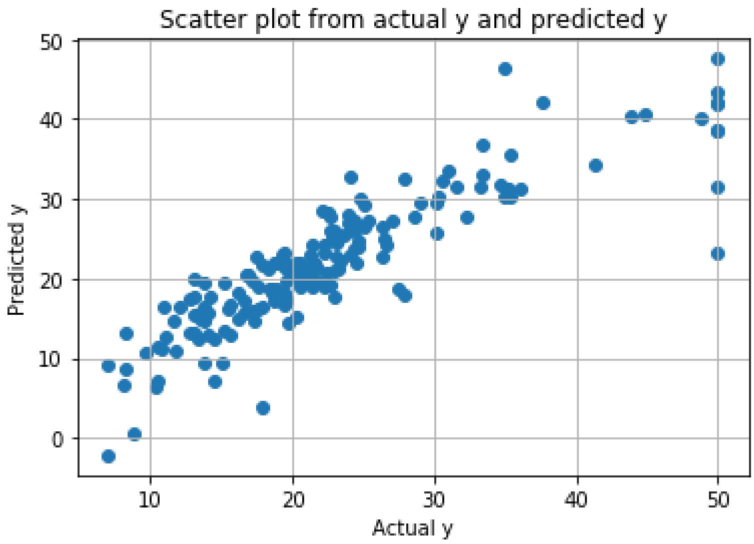
```
#Scatter plot of actual price vs predicted price

plt.scatter(y_test,y_pred)
plt.xlabel('Actual price')
plt.ylabel('Predictd price')
plt.title('Actual price vs Predicted price')
plt.show()
```

In [15]:

```
# SkLearn SGD classifier
n_iter=1000
clf = SGDRegressor(max_iter=n_iter)
clf.fit(X_train, Y_train)
y_pred_sgd=clf.predict(x_test)
plt.scatter(y_test,y_pred_sgd)
plt.grid()
plt.xlabel('Actual y')
plt.ylabel('Predicted y')
plt.title('Scatter plot from actual y and predicted y')
plt.show()

print('Mean Squared Error :',mean_squared_error(y_test, y_pred_sgd))
```




```
Mean Squared Error : 21.617364567315395
```

In [16]:

```
plt.figure(1)
# Implemented sklearn
plt.subplot(211)
sns.set_style('whitegrid')
sns.kdeplot(np.array(y_pred), bw=0.5)
plt.title('Sklearn Implementation')
plt.show()
# Implemented SGD
plt.subplot(212)
sns.set_style('whitegrid')
sns.kdeplot(np.array(y_pred_sgd))
plt.title('SGD Implementation')
plt.show()
```