In [2]:
```
from sklearn.datasets import load_boston
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
%matplotlib inline
import numpy as np
import pandas as pd
from sklearn import preprocessing
from tqdm.notebook import tqdm
import warnings
warnings.filterwarnings("ignore")
boston=load_boston()
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_absolute_error
from sklearn.linear_model import SGDRegressor
from prettytable import PrettyTable
```

In [13]:
```
x=load_boston().data
y=load_boston().target
df=pd.DataFrame(x)
df.head()
```

Out[13]:

	0	1	2	3	4	5	6	7	8	9	10	11	12
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
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
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
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
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

In [7]:
```
x_train, x_test, y_train, y_test=train_test_split(x, y, test_size=0.3,
random_state=4)
```

```
std=preprocessing.StandardScaler()
x_train=std.fit_transform(x_train)
x_test=std.transform(x_test)

xtr_df=pd.DataFrame(x_train)
xtr_df['price']=y_train
xtr_df.shape
xtr_df.head()
```

Out[7]:

	0	1	2	3	4	5	6	7	
0	-0.425469	-0.470768	-0.954686	-0.231455	-0.919581	0.215100	-0.747410	0.454022	-
1	-0.426323	2.992576	-1.330157	-0.231455	-1.227311	-0.883652	-1.691588	3.163428	-
2	-0.385190	-0.470768	-0.705828	4.320494	-0.423795	-0.125423	0.818985	-0.353904	-
3	-0.249268	-0.470768	-0.423497	-0.231455	-0.158805	-0.228336	1.021567	-0.021755	-
4	-0.365945	0.395068	-1.030363	-0.231455	0.157472	3.102729	-0.060078	-0.646202	-

In [28]:

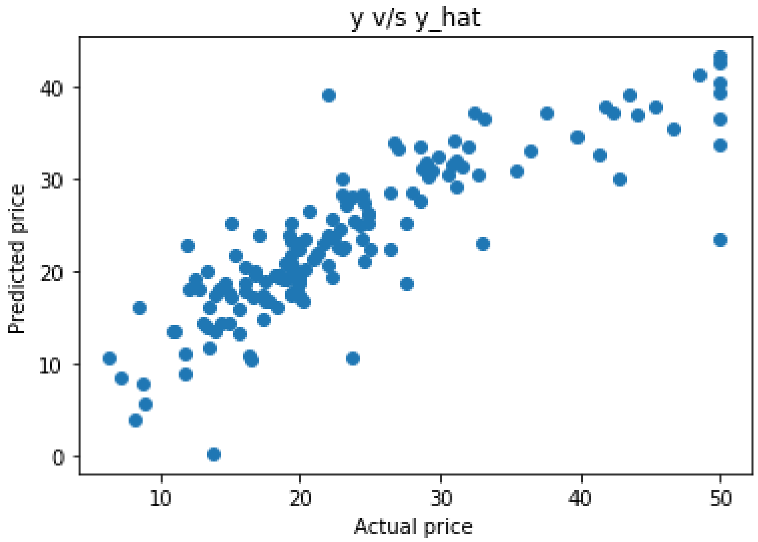
```
#SGD self implementation
W,B,iteration,lr_rate,k=np.zeros(shape=(1,13)),0,1000,0.01,25 #intialis
e vector W to zero ,scalar B to zero , iteration=1000 , learning rate=
0.01,k=batchsize=25

for itr in tqdm(range(iteration)):
    w,b,tem_vec,tem_incpt=W,B,np.zeros(shape=(1,13)),0
    new_data=xtr_df.sample(25) #sampling random k=batch_size=25 data
    x=np.array(new_data.drop('price',axis=1)) #x stores sampled data
    y=np.array(new_data['price']) #y stores sampled data

    for i in range(k): # for eacch itr :i runs for 25 times
        tem_vec=tem_vec+(-2)*x[i]*(y[i]-(np.dot(w,x[i])+b)) #differenti
ated eqn
        tem_incpt=tem_incpt+(-2)*(y[i]-(np.dot(w,x[i])+b))
    W=(w-lr_rate*(tem_vec)/k)   #Calculating weight
    B=(b-lr_rate*(tem_incpt)/k)
```

```
print(W)
print(B)
#https://numpy.org/doc/stable/reference/generated/numpy.dot.html
```

```
[[-1.050332    1.11214712 -0.15314985  1.22872066 -1.60212414  1.995995
82
  -0.01165838 -3.20705273  2.41806794 -1.4724067  -1.6783505   0.731526
97
  -3.74621601]]
[22.11069232]
```

In [17]:
```
y_hat=[]
for i in range(len(x_test)):
    pred_val=np.dot(W,x_test[i])+B
    y_hat.append(np.asscalar(pred_val))
#https://www.geeksforgeeks.org/numpy-asscalar-in-python
```

In [18]:
```
plt.scatter(y_test,y_hat)
plt.xlabel("Actual price")
plt.ylabel("Predicted price")
plt.title("y v/s y_hat")
plt.show()
```




```
In [19]: mse=mean_squared_error(y_test,y_hat)
         mae=mean_absolute_error(y_test,y_hat)
         print("MSE",mse)
         print("MAE",mae)
```

```
MSE 28.65801524816916
MAE 3.7283840916214435
```

Implementing SGD using sklearn

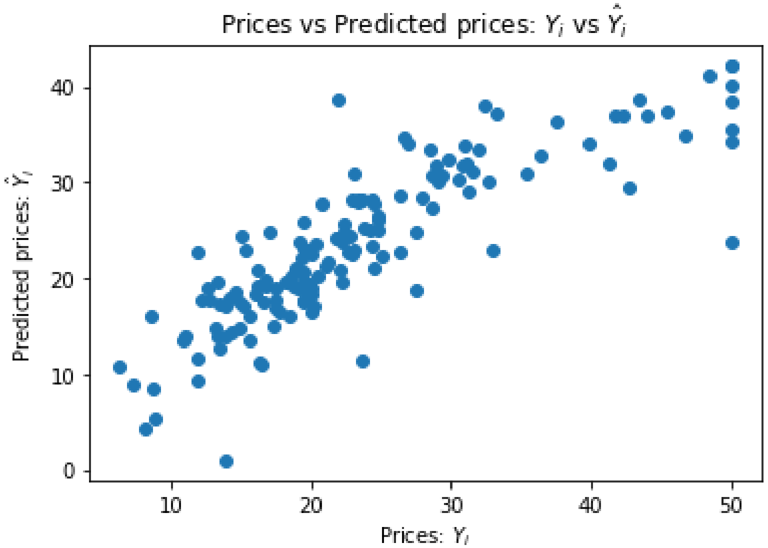
```
In [20]: #Sklearn SGD implemention, using previously used train and test data
         sgd = SGDRegressor()
         sgd.fit(x_train, y_train)
```

```
Out[20]: SGDRegressor()
```

```
In [21]: y_hat_sgd=sgd.predict(x_test)
```

```
In [22]: plt.scatter(y_test,y_hat_sgd)
```

```
plt.xlabel("Prices: $Y_i$")
plt.ylabel("Predicted prices: $\hat{Y}_i$")
plt.title("Prices vs Predicted prices: $Y_i$ vs $\hat{Y}_i$")
plt.show()
```



In [23]:
```
mse=mean_squared_error(y_test,y_hat_sgd)
mae=mean_absolute_error(y_test,y_hat_sgd)
print("MSE",mse)
print("MAE",mae)
```

```
MSE 29.67038102430654
MAE 3.8144001829398215
```

In [39]:
```
sklearn_sgd_weight=sgd.coef_
```

Conclusion

In [52]:
```
#Table showing weights
x = PrettyTable()
```

```
column_names = ['Self SGD_weight','Sklearn SGD_weight']
x.add_column(column_names[0],W[0])
x.add_column(column_names[1],sklearn_sgd_weight)
print(x)
```

```
+----------------------+----------------------+
|   Self SGD_weight    |  Sklearn SGD_weight  |
+----------------------+----------------------+
| -0.8643778323074938  | -1.0271535187514829  |
|  1.1121891228927454  |  1.1519585734764535  |
| -0.41170904540119496 | -0.39549543773182705 |
|  0.9205482351334228  |  1.0841315811744174  |
| -1.4766658720815533  |  -1.581813998706039  |
|  2.1491262329910668  |  2.2706767046163994  |
| -0.22466228228844884 | -0.15760285204111085 |
|  -3.179122673966019  | -3.1817416584700062  |
|  1.9064389677492497  |  2.0353124571773886  |
|  -1.401666361585271  | -1.5351530375854299  |
| -1.5979972483299938  |  -1.751320327297852  |
|  0.9587038141558701  |  0.849678498833273   |
|  -3.56575966492354   |  -3.730305610421711  |
+----------------------+----------------------+
```

In [3]:
```
#Table showing errors
x= PrettyTable()
x.field_names=['Model','Error Type','Error']
x.add_row(['Self SGD','MSE',29.676320412098082])
x.add_row(['Self SGD','MAE',3.779891666092997])
x.add_row(['Sklearn SGD','MSE',29.935375112161434])
x.add_row(['Sklearn SGD','MAE',3.7999981134575314])
print(x)
```

```
+-------------+------------+--------------------+
|    Model    | Error Type |       Error        |
+-------------+------------+--------------------+
|   Self SGD  |    MSE     | 29.676320412098082 |
|   Self SGD  |    MAE     | 3.779891666092997  |
| Sklearn SGD |    MSE     | 29.935375112161434 |
| Sklearn SGD |    MAE     | 3.7999981134575314 |
+-------------+------------+--------------------+
```

Considering the above tables we can say that "Self SGD" and "Sklearn SGD" are giving almost same results and doing its best