chandanachandu124@gmail.com_assignment-6

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In [52]:
```
import warnings
warnings.filterwarnings("ignore")
from sklearn.datasets import load_boston
from random import seed
from random import randrange
from csv import reader
from math import sqrt
from sklearn import preprocessing
import pandas as pd
import numpy as np
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
```

In [53]:
```
X = load_boston().data
Y = load_boston().target
```

In [54]:
```
scaler = preprocessing.StandardScaler().fit(X)
X = scaler.transform(X)
```

In [55]:
```
clf = SGDRegressor()
clf.fit(X, Y)
print(mean_squared_error(Y, clf.predict(X)))
```

```
23.00034360224337
```

In [56]:
```
df=pd.DataFrame(X)
#some intuition
df[13]=df[10]//df[12]   #here we set a column 13 such that df[13]=Boston_data['Medv']/
X=df.as_matrix()
df.head()
```

Out[56]:
```
          0         1         2         3         4         5         6  \
0 -0.417713  0.284830 -1.287909 -0.272599 -0.144217  0.413672 -0.120013
1 -0.415269 -0.487722 -0.593381 -0.272599 -0.740262  0.194274  0.367166
```

```
2 -0.415272 -0.487722 -0.593381 -0.272599 -0.740262  1.282714 -0.265812
3 -0.414680 -0.487722 -1.306878 -0.272599 -0.835284  1.016303 -0.809889
4 -0.410409 -0.487722 -1.306878 -0.272599 -0.835284  1.228577 -0.511180

         7         8         9        10        11        12   13
0  0.140214 -0.982843 -0.666608 -1.459000  0.441052 -1.075562  1.0
1  0.557160 -0.867883 -0.987329 -0.303094  0.441052 -0.492439  0.0
2  0.557160 -0.867883 -0.987329 -0.303094  0.396427 -1.208727  0.0
3  1.077737 -0.752922 -1.106115  0.113032  0.416163 -1.361517 -1.0
4  1.077737 -0.752922 -1.106115  0.113032  0.441052 -1.026501 -1.0
```

In [57]:
```
#Splitting whole data into train and test
from sklearn.model_selection  import train_test_split
X_train, X_test, y_train, y_test=train_test_split(X, Y, test_size=0.3, random_state=4

# applying column standardization on train and test data

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
df_train.head()
```

Out[57]:
```
          0         1         2         3         4         5         6  \
0 -0.425469 -0.470768 -0.954686 -0.231455 -0.919581  0.215100 -0.747410
1 -0.426323  2.992576 -1.330157 -0.231455 -1.227311 -0.883652 -1.691588
2 -0.385190 -0.470768 -0.705828  4.320494 -0.423795 -0.125423  0.818985
3 -0.249268 -0.470768 -0.423497 -0.231455 -0.158805 -0.228336  1.021567
4 -0.365945  0.395068 -1.030363 -0.231455  0.157472  3.102729 -0.060078

          7         8         9        10        11        12         13  price
0  0.454022 -0.764468 -0.976012  0.005460  0.441889 -0.444819 -0.100764   23.9
1  3.163428 -0.651568 -0.464548  1.616046  0.287498 -0.666438 -0.195005   18.2
2 -0.353904 -0.199967 -0.623278 -0.500725  0.423713  1.226505 -0.100764   21.7
3 -0.021755 -0.651568 -0.623278  1.155878 -1.185126  1.068407 -0.006522   13.5
4 -0.646202 -0.538668 -0.876071 -2.525462  0.306551 -0.752545  0.087719   50.0
```

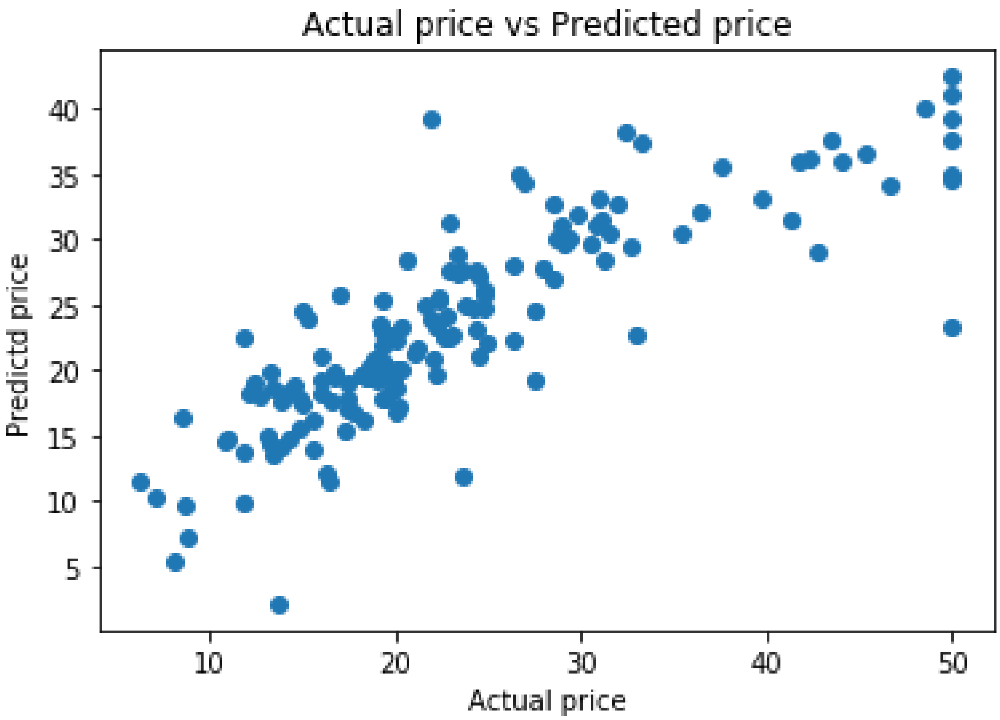
In [58]:
```
#SGD implementation for linear regression
#function having parameter X_train,y_train,no of iteration,learning rate r
#intialising no of iteration=100,learning rate =0.01
#batch size=20



W,B,iteration,lr_rate,k=np.zeros(shape=(1,14)),0,750,0.01,25 #intialise W and B to ze
```

```
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=20 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
        temp_intercept+=(-2)*(y[i]-(np.dot(w,x[i])+b))#partial differentiation wrt b

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

    iteration-=1


print(W)
print(B)
```

```
[[-0.88306127  1.10983464 -0.31906405  1.26577969 -1.48507253  2.22580003
  -0.18915912 -3.01961755  1.86039206 -1.37960624 -1.64084106  0.74067193
  -3.47527654  0.06518038]]
[22.14467274]
```

In [59]:
```
#prediction on x_test
#https://www.geeksforgeeks.org/numpy-asscalar-in-python/
y_predic_lr=[]
for i in range(len(X_test)):
    val=np.dot(W,X_test[i])+B  #val= wTx+b
    y_predic_lr.append(np.asscalar(val))
```

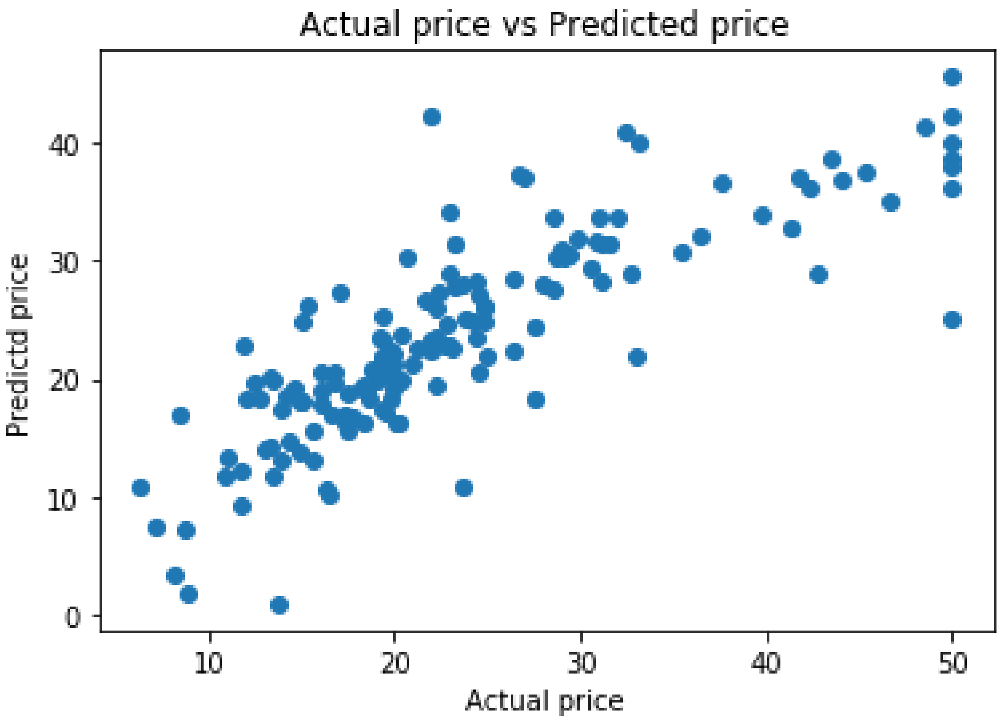
In [60]:
```
#Scatter plot of actual price vs predicted price

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




```
In [61]: MSE_lr=mean_squared_error(y_test,y_predic_lr)
         print('mean squared error =',MSE_lr)
```

```
mean squared error = 31.239830632733
```

```
In [62]: #SGD regression sklearn implementation

         #intialising no of iteration=100,eta0=1
         #taking t=2 and power_t=1 such that for each iteration eta0=eta0/pow(2,1) ,it means h

         model=SGDRegressor(learning_rate='constant',eta0=0.01,penalty=None,n_iter=100,max_ite
         model.fit(X_train,y_train)
         y_pred_sgd=model.predict(X_test)

         #Scatter plot of actual price vs predicted price

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




```
In [63]: MSE_sgd=mean_squared_error(y_test,y_pred_sgd)
         print('mean squared error =',MSE_sgd)
```

```
mean squared error = 33.529161913896125
```

```
In [64]: #Comparison between weights obtained from own implementation and weights obtained fro
         from prettytable import PrettyTable
         x = PrettyTable()
         x.field_names=['Weight vector manual','Weight vector SGD sklearn']
         weight_sgd=model.coef_
         for i in range(13):
             x.add_row([W[0][i],weight_sgd[i]])
         print(x)
```

```
+----------------------+---------------------------+
| Weight vector manual | Weight vector SGD sklearn |
+----------------------+---------------------------+
| -0.8830612711865389  |    -1.3769808057338275    |
|  1.1098346413329043  |     1.2578217208213538    |
| -0.31906404677416117 |    0.22615712805089083    |
|  1.2657796946846447  |     1.6520436404957028    |
| -1.4850725316167526  |    -1.6577036484675904    |
|  2.225800033412804   |     2.2316449407595993    |
```

```
| -0.18915911906972485 |    -0.1754401651340977    |
|  -3.019617552643329  |    -3.4309684244613585    |
|  1.8603920616553935  |     3.0164500459120447    |
| -1.3796062365313495  |    -2.2965400786352883    |
| -1.6408410603295547  |    -1.7885105658537956    |
|  0.7406719308170109  |     1.2393999240996039    |
| -3.4752765420614797  |    -3.9580001664848594    |
+----------------------+--------------------------+
```

In [65]:
```python
#comparison between MSE of own implementation and SGD sklearn implementation
print('MSE of manual implementation = ',MSE_lr)
print('-'*50)
print('MSE of SGD sklearn implementation = ',MSE_sgd)
```

```
MSE of manual implementation =  31.239830632733
--------------------------------------------------
MSE of SGD sklearn implementation =  33.529161913896125
```

In [ ]:
```
1. After seeing the distribution of Median value of owner-occupied homes in $1000's and
2. Then We splitted whole dataset into train and test and then standardised it
3. Then After we then initialised learning rate to constant and equal to 0.01 , no of i
4. After that we have calculated partial derivative with respect to w and b in each ite
5. Then we predicted y_test and plotted scatter plot between actual y and predicted y a
6. In our next step we applied SGD regressor in sklearn and compared weight ,mean squar
   And we observed that weights , scatter plots and mean squared error were nearly equa
```