06 Implement SGD

January 24, 2019

```
In [1]: 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 [2]: 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]: X = load_boston().data
        Y = load_boston().target
```

```
In [6]: scaler = preprocessing.StandardScaler().fit(X)
        X = scaler.transform(X)
```

```
In [7]: bos = pd.DataFrame(boston.data)
        print(bos.head())
```

```
        0     1     2    3      4      5     6       7    8      9     10  \
0  0.00632  18.0  2.31  0.0  0.538  6.575  65.2  4.0900  1.0  296.0  15.3
1  0.02731   0.0  7.07  0.0  0.469  6.421  78.9  4.9671  2.0  242.0  17.8
2  0.02729   0.0  7.07  0.0  0.469  7.185  61.1  4.9671  2.0  242.0  17.8
3  0.03237   0.0  2.18  0.0  0.458  6.998  45.8  6.0622  3.0  222.0  18.7
4  0.06905   0.0  2.18  0.0  0.458  7.147  54.2  6.0622  3.0  222.0  18.7

       11    12
0  396.90  4.98
1  396.90  9.14
2  392.83  4.03
3  394.63  2.94
4  396.90  5.33
```

```
In [8]: bos['PRICE'] = boston.target

        X = bos.drop('PRICE', axis = 1)
        Y = bos['PRICE']
```

```
In [83]: scaler = preprocessing.StandardScaler().fit(X)
         X = scaler.transform(X)
```

```
In [96]: from sklearn import cross_validation
         X_train, X_test, Y_train, Y_test = cross_validation.train_test_split(X, Y, test_size =
         print(X_train.shape)
         print(X_test.shape)
         print(Y_train.shape)
         print(Y_test.shape)
```

```
(339, 13)
(167, 13)
(339,)
(167,)
```

```
In [110]: clf = SGDRegressor(alpha=0.01)
          clf.fit(X, Y)
          print(mean_squared_error(Y_test, clf.predict(X_test)))
```

```
26.93189673099861
```

```
In [111]: sklearn_W = clf.coef_
          sklearn_b = clf.intercept_
```

0.0.1 own sgd Implementation

```
In [127]: def SGD(X_train, Y_train, learning_rate=0.01, n_iter = 1000, batch_size = 200):
              W = np.zeros(X_train.shape[1])
```

```
    b = 0.0
    r = learning_rate
    rt_power = 0.25
    for i in range(1,n_iter+1):
        idx = np.random.randint(0, len(X_train),batch_size)
        x_k = X_train[idx]
        y_k = Y_train[idx]
        N = float(batch_size)
        error = y_k - (np.dot(x_k, W) - b)
        W -= r * (-2/N) * x_k.T.dot(error)
        b -= r * np.sum(error)
        r = learning_rate / pow(i, rt_power)
    return W, abs(b)
```

In [128]:
```
W, b = SGD(X,Y)
```

In [129]:
```
W
```

Out[129]:
```
array([-0.67413219,  0.5806372 , -0.42776069,  0.77507576, -0.99597728,
        3.17937914, -0.19316828, -2.10391887,  0.8655778 , -0.53894101,
       -1.83358058,  0.91160332, -3.36927039])
```

In [130]:
```
b
```

Out[130]:
```
22.595750477577788
```

In [131]:
```
pred = X_test.dot(W) + b
```

In [132]:
```
MSE = mean_squared_error(Y_test, pred)
```

In [133]:
```
MSE
```

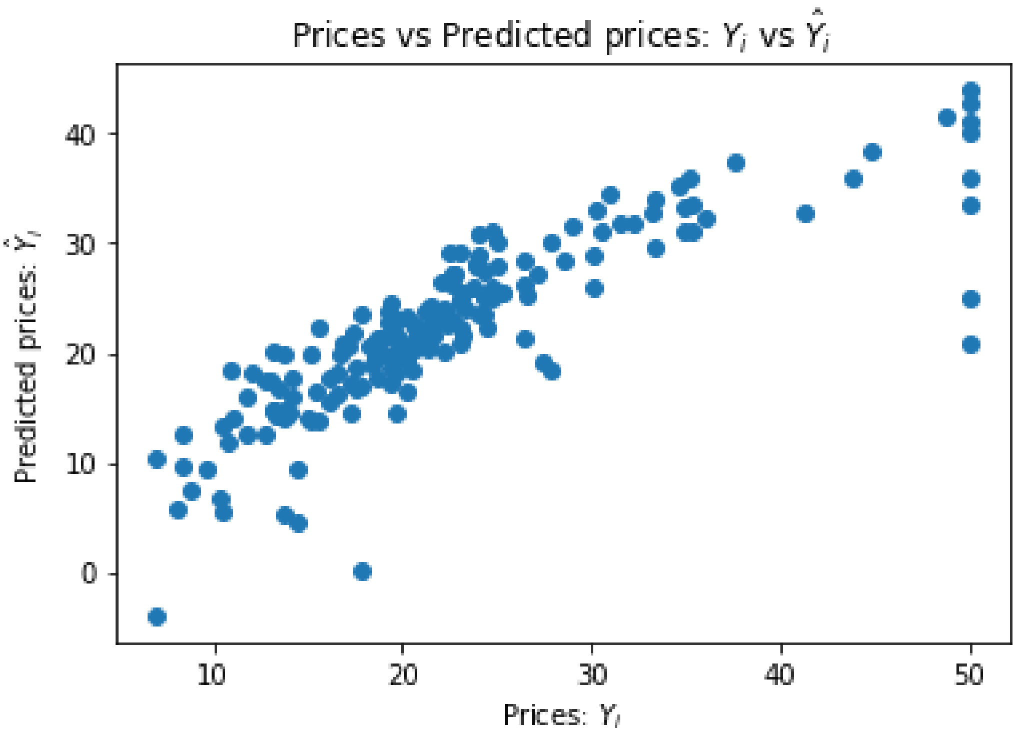
Out[133]:
```
27.05120620133145
```

0.0.2 predicted values v/s actual values

In [134]:
```
# code source:https://medium.com/@haydar_ai/learning-data-science-day-9-linear-regre
from sklearn.linear_model import LinearRegression
%matplotlib inline
import matplotlib.pyplot as plt


Y_pred = pred

plt.scatter(Y_test, Y_pred)
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()
```



0.0.3 chart of predicted values v/s actual values

```
In [135]: acutal = list(Y_test)
          predicted = list(Y_pred)
```

```
In [136]: print("actual values v/s predicted\n")
          for i in range(len(acutal)):
              print("%f \t %f"%(acutal[i] , predicted[i]))
```

```
actual values v/s predicted

37.600000          37.375569
27.900000          30.048159
22.600000          27.164871
13.800000          5.355200
35.200000          35.902943
10.400000          6.646771
23.900000          27.917514
29.000000          31.553187
22.800000          27.183857
23.200000          21.691713
33.200000          32.816749
19.000000          21.313788
```

20.300000	23.238460
36.100000	32.206616
24.400000	27.534659
17.200000	17.219575
17.900000	0.232393
19.600000	19.319231
19.700000	14.570873
15.000000	14.147063
8.100000	5.898771
23.000000	20.776961
44.800000	38.281860
23.100000	24.532152
32.200000	31.789490
10.800000	11.821311
23.100000	25.000656
21.200000	23.839150
22.200000	23.062710
24.100000	23.436042
17.300000	14.473725
7.000000	10.372603
12.700000	17.534814
17.800000	23.488554
26.400000	28.334708
19.600000	20.152030
25.100000	30.130981
8.300000	9.680069
48.800000	41.537782
34.900000	33.367630
13.800000	19.853368
14.400000	4.552592
30.100000	28.857315
12.700000	12.577188
27.100000	27.130407
24.800000	31.038018
7.000000	-3.942816
20.500000	18.449914
21.500000	22.475579
14.000000	14.513333
20.400000	20.862346
22.200000	20.070116
21.400000	24.136552
13.500000	14.476340
19.400000	18.646675
24.700000	25.859367
43.800000	36.025187
14.100000	16.031596
28.600000	28.414920
19.700000	21.312331

16.800000	20.931281
23.200000	25.440515
16.200000	15.476305
41.300000	32.654584
22.700000	23.076221
8.300000	12.655471
18.400000	20.628324
24.700000	24.940677
21.700000	21.663592
20.600000	20.373578
16.700000	19.961516
22.100000	26.400737
19.400000	17.316550
27.500000	19.133106
27.900000	18.479923
30.100000	25.956618
17.400000	21.930549
15.400000	16.441173
31.000000	34.395415
14.200000	17.797422
19.600000	21.538310
50.000000	42.761446
21.700000	23.461283
11.700000	15.927102
19.400000	24.608908
13.000000	17.468966
17.500000	18.626358
9.700000	9.349649
20.300000	19.327596
18.600000	19.537240
50.000000	36.025385
19.600000	18.259078
21.400000	20.958557
18.400000	18.853227
22.600000	26.230720
25.000000	27.838200
15.600000	13.786135
26.600000	25.132454
22.400000	22.595148
13.100000	14.663969
23.000000	22.332422
24.500000	22.197823
13.100000	14.752905
50.000000	44.064727
8.800000	7.375388
20.600000	22.395009
12.100000	18.200549
50.000000	20.960225

24.100000	28.847790
16.100000	17.665832
23.900000	28.212302
24.300000	23.593537
13.100000	20.159721
30.300000	33.054078
15.200000	19.797778
13.800000	14.167284
26.400000	21.381511
16.600000	18.221857
18.900000	19.781838
17.600000	16.643520
18.700000	21.358814
33.400000	33.999282
20.700000	22.525399
17.100000	20.664044
23.400000	24.025095
26.500000	26.298582
21.400000	20.251396
21.500000	24.148385
19.200000	23.882737
50.000000	40.111622
50.000000	40.905903
23.000000	29.067877
10.500000	13.292929
17.800000	17.083084
10.900000	18.506063
21.000000	21.787066
13.800000	14.864155
10.500000	5.659188
22.200000	23.987468
30.500000	31.057239
19.400000	22.824881
15.600000	22.211114
20.200000	16.510354
19.300000	22.895657
34.600000	35.118097
50.000000	24.875253
24.000000	30.780451
18.700000	17.706931
19.800000	22.977074
22.500000	29.134828
13.300000	14.373256
50.000000	33.607708
11.800000	12.585493
11.000000	14.029992
23.700000	26.043526
35.400000	31.035287

```
15.200000          13.830639
24.400000          25.047405
33.400000          29.597219
31.600000          31.767734
13.400000          16.782462
34.900000          31.118824
14.400000          9.483307
35.400000          33.530729
25.300000          25.410127
18.300000          20.631338
16.600000          16.288110
```

0.0.4 compare the weights

```
In [137]: sklear_W = list(sklearn_W)
          own_W = list(W)
```

```
In [138]: print("Sklearn   v/s     own\n")
          print("="*50)
          for i in range(len(own_W)):
              print("%f \t %f"%(sklearn_W[i] , own_W[i]))
          print("\n\m intersept terms ")
          print("="*50)
          print("%f \t %f"%(sklearn_b, b))
```

```
Sklearn   v/s     own

==================================================
-0.652352          -0.674132
0.547772          0.580637
-0.318632          -0.427761
0.748774          0.775076
-1.195099          -0.995977
2.993560          3.179379
-0.085829          -0.193168
-2.042773          -2.103919
0.959533          0.865578
-0.463772          -0.538941
-1.927536          -1.833581
0.812226          0.911603
-3.551600          -3.369270

\m intersept terms
==================================================
22.363482          22.595750
```

```
In [140]: x = PrettyTable(["Implimentation", "learning_rate", "MSE"])

          x.add_row(["sk_learn" , "0.01", 26.931])
          x.add_row(["own","0.01", 27.051])

          print(x.get_string(title="SGD Model"))
```

```
+----------------+---------------+--------+
| Implimentation | learning_rate |  MSE   |
+----------------+---------------+--------+
|    sk_learn    |      0.01     | 26.931 |
|      own       |      0.01     | 27.051 |
+----------------+---------------+--------+
```

```
In [ ]:
```