Implement_SGD

March 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 [49]: X = load_boston().data
         Y = load_boston().target
```

```
In [50]: scaler = preprocessing.StandardScaler().fit(X)
         X = scaler.transform(X)
```

```
In [173]: clf = SGDRegressor(n_iter=1000)
          clf.fit(X, Y)
          print(mean_squared_error(Y, clf.predict(X)))
```

```
21.902843787689253
```

```
c:\users\rites\appdata\local\programs\python\python36\lib\site-packages\sklearn\linear_model\st
  DeprecationWarning)
```

Custom SGD Regressor

```
In [174]: class MySGD:
              def __init__(self):
                  self.weight_vect = list() # This weight vector is accessible to all methods
```

```
    def predict_yi(self,X_i):
        Y_i = self.weight_vect[0]    # Initializing Y_i with W[0]. Here W[0] is b0 of
        #print(X_i.shape)
        for i in range(len(X_i)):
            Y_i += X_i[i]*self.weight_vect[i+1]    # Yi = b0 + b1*x1 + .....+bn*xn
        return Y_i


    def fit(self,X_train,Y,n_iter=1000,lrn_rate=0.001):
        W = np.zeros(len(X_train[0])+1) # Initilalizing Weight vectors with length n
        self.weight_vect = W
        #print("In fit method",len(seW))
        for k in range(n_iter):
            sum_error = 0
            i=0
            for row in X_train:
                error = self.predict_yi(row)-Y[i]
                #print(error)
                i += 1
                sum_error += error**2  # storing squared error to understand the imp
                W[0] = W[0] - 2*lrn_rate*error  # Updating coefficient b0
                for j in range(len(row)):
                    W[j+1] = W[j+1] -2*lrn_rate*error*row[j]  # Updating Weight vect
            self.weight_vect = W

    def predict(self,X_i):
        Y1 = []
        for row in X_i:
            Y1.append(self.predict_yi(row))
        return Y1
```

In [175]:
```
# Training my custom model
model = MySGD()
model.fit(X,Y)
```

MSE of custom and sklearn's SGD

In [176]:
```
print("MSE of Custom SGD",mean_squared_error(Y,model.predict(X)))
print("MSE of Sklearn's SGD",mean_squared_error(Y,clf.predict(X)))
```

```
MSE of Custom SGD 22.34230911750648
MSE of Sklearn's SGD 21.902843787689253
```

Chart of Actual Yi Vs Custom SGD Predicted Yi

In [177]:
```
import matplotlib.pyplot as plt
plt.scatter(Y,model.predict(X))
```

```
plt.title("Actual Yi Vs Predicted Yi")
plt.xlabel("Actual Yi")
plt.ylabel("Predicted Yi")
plt.show()
```

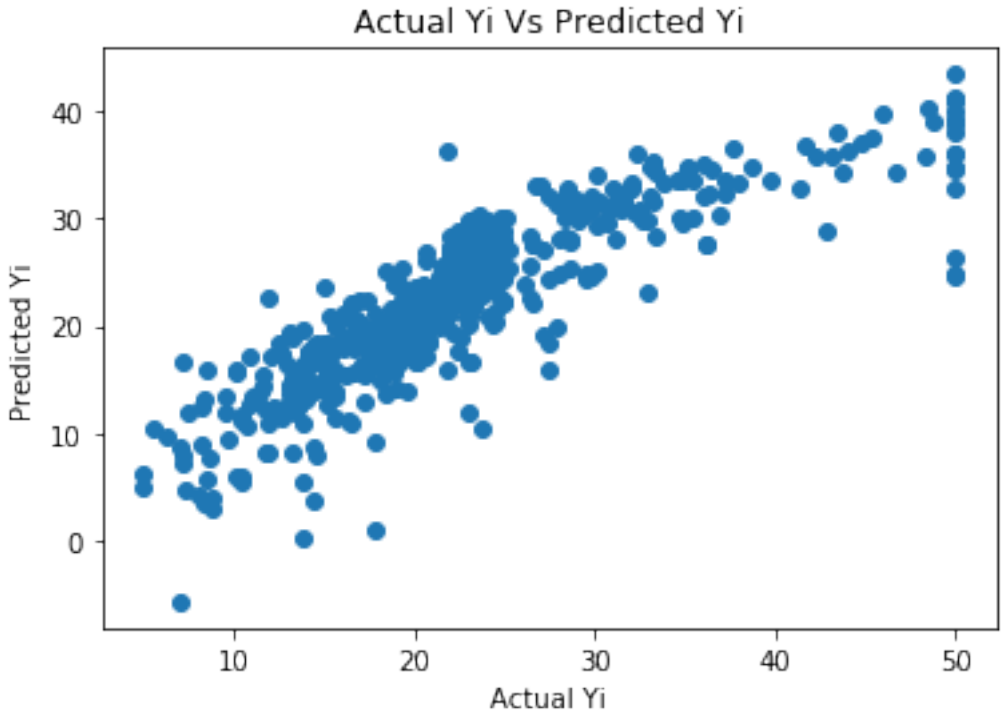
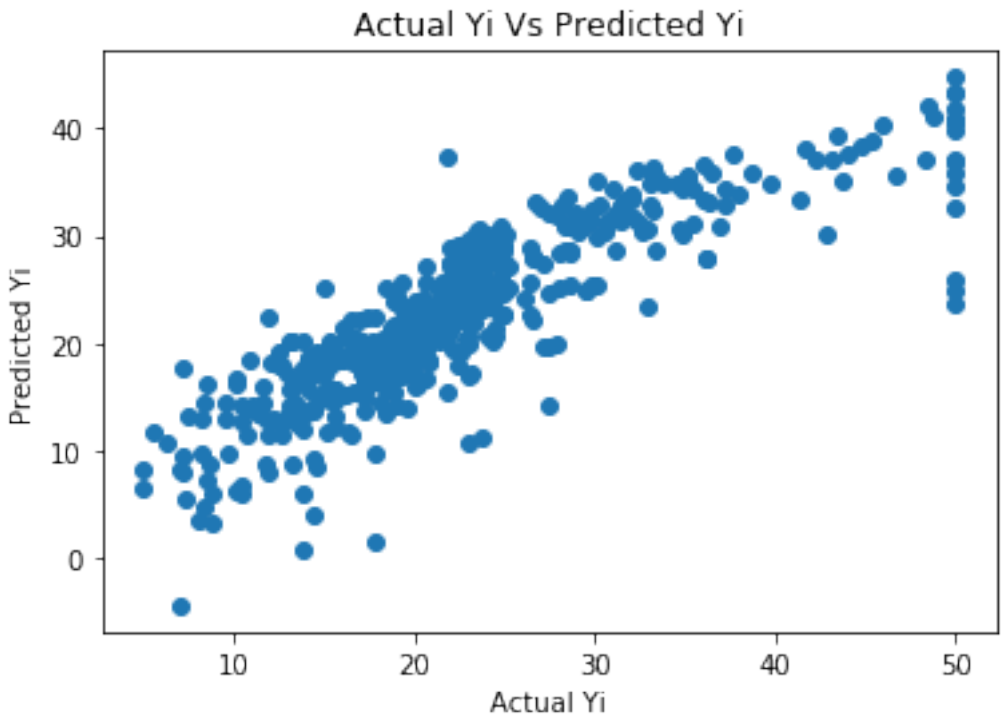


Chart of Actual Yi Vs Sklearn's SGD Predicted Yi

In [178]:
```
plt.scatter(Y,clf.predict(X))
plt.title("Actual Yi Vs Predicted Yi")
plt.xlabel("Actual Yi")
plt.ylabel("Predicted Yi")
plt.show()
```



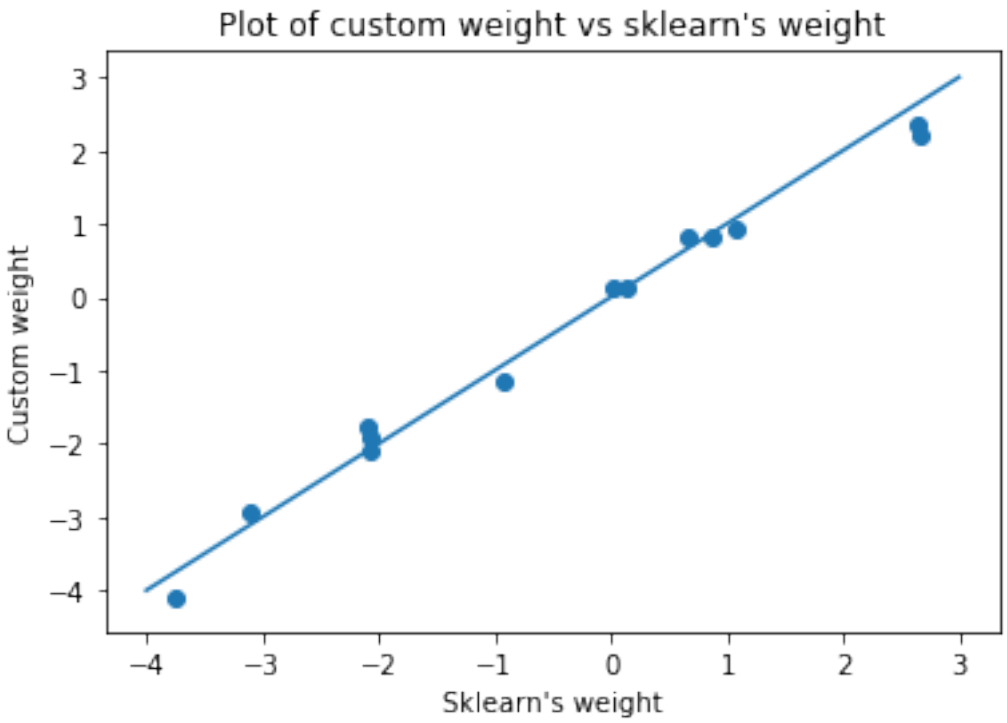
Compairing weights of Custom SGD with Sklearn's SGD

```
In [179]: from prettytable import PrettyTable

          # Initializing table object
          x = PrettyTable(['Features','weight of custom SGD','weight of sklearn SGD'])

          # Getting weight of custom SGD
          custom_lst  = []
          for i in model.weight_vect[1:]: # model.weight_vect returns weight vectors of each f
                                          # be careful take weights from index 1 as bo is not
              custom_lst.append(i)

          # Getting weight of sklearn's SGD
          sklearn_lst  = []
          for i in clf.coef_: # clf.coef_ returns weight vectors of each feature
              sklearn_lst.append(i)


          # List containing features
          feat_lst = ['f1','f2','f3','f4','f5','f6','f7','f8','f9','f10','f11','f12','f13']

          # Combining all three lists to form a table
          for i in range(len(feat_lst)):
              lst = []
```

```
            lst.append(feat_lst[i])
            lst.append(custom_lst[i])
            lst.append(sklearn_lst[i])
            x.add_row(lst)

        print(x)
```

```
+----------+----------------------+-----------------------+
| Features | weight of custom SGD | weight of sklearn SGD |
+----------+----------------------+-----------------------+
|    f1    | -1.1415400509783526  |  -0.9288534041434803  |
|    f2    |  0.9280768640558514  |   1.0855180740541848  |
|    f3    | 0.13713817112631482  |  0.12984315327069687  |
|    f4    |  0.8116259919404395  |   0.6732379012855269  |
|    f5    | -2.1008560668485896  |   -2.071016874038316  |
|    f6    |  2.1902426015148437  |   2.672083086014879   |
|    f7    | 0.11366874716565632  |  0.01620787179637586  |
|    f8    |  -2.929207337842744  |  -3.0989761960219626  |
|    f9    |  2.352415343181041   |   2.647401930512593   |
|   f10    | -1.7750918198969137  |  -2.0857086550012975  |
|   f11    | -1.9277983019473979  |   -2.069613449247915  |
|   f12    |  0.837471831628346   |   0.8670442325933713  |
|   f13    |  -4.100508708697415  |  -3.7568860822317447  |
+----------+----------------------+-----------------------+
```

In [180]:
```
# printing a plot of custom weights vs sklearns's weight
x = [-4,-3,-2,-1,0,1,2,3]
plt.plot(x,x)
plt.scatter(sklearn_lst,custom_lst)
plt.title("Plot of custom weight vs sklearn's weight")
plt.xlabel("Sklearn's weight")
plt.ylabel("Custom weight")
plt.plot()
plt.show()
```



Observation

1.The weights returned by custom SGD is very close to weights returned by Sklearn SGD

2.In the plot above we can ssee that most of the points are very close to the straight line

MSE of custom SGD and sklearn's SGD

```
In [181]: print("MSE of Custom SGD",mean_squared_error(Y,model.predict(X)))
          print("**********************************************************")
          print("MSE of Sklearn's SGD",mean_squared_error(Y,clf.predict(X)))
```

```
MSE of Custom SGD 22.34230911750648
**********************************************************
MSE of Sklearn's SGD 21.902843787689253
```

Conclusion

1. The plot of custom SGD predicted yi vs actual yi and of sklearn SGD predicted yi vs actual yi are almost similar.
2. The weights returned by custom SGD and sklearn SGD are very close as can be seen in the plot. Most of the points are very close to the dtraight line.
3. The MSE of custom SGD and sklearn SGD are very close . To be precise custom SGD's MSE is slightly less than that of sklearn SGD.

```
In [ ]:
```