Multiple Linear Regression

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Multiple LR

We have another example of multivariable data like below.

Three independent variables

x_1	x_2	x_3	y
3.9	2.1	7.5	19.05
2.1	3.2	4.5	13.25
4.7	4.1	7.8	22.05
8.5	5.4	1.2	12.05
1.9	3.4	6.2	16.75
6.3	4.3	7.7	22.85
8.9	4.4	3.3	15.45

```python
import numpy as np

data = np.array([[3.9,2.1,7.5,19.05],
                 [2.1,3.2,4.5,13.25],
                 [4.7,4.1,7.8,22.05],
                 [8.5,5.4,1.2,12.05],
                 [1.9,3.4,6.2,16.75],
                 [6.3,4.3,7.7,22.85],
                 [8.9,4.4,3.3,15.45]])
x = data[:, :-1]
y = data[:, -1]

# initialization
w1, w2, w3 = 0, 0, 0
b = 0

# learning rate
alpha = 0.05

# GD
for i in range(10000):
    w1 = w1 - alpha * (1 / len(data)) * sum((x[:, 0]*w1+x[:, 1]*w2+x[:, 2]*w3 + b - y) * x[:, 0])
    w2 = w2 - alpha * (1 / len(data)) * sum((x[:, 0]*w1+x[:, 1]*w2+x[:, 2]*w3 + b - y) * x[:, 1])
    w3 = w3 - alpha * (1 / len(data)) * sum((x[:, 0]*w1+x[:, 1]*w2+x[:, 2]*w3 + b - y) * x[:, 2])
    b = b - alpha * (1/len(data)) * sum(x[:, 0]*w1+x[:, 1]*w2+x[:, 2]*w3 + b - y)
print("w1 = %f, w2 = %f, w3 = %f, b = %f" % (w1, w2, w3, b))
```

Multiple LR

Answer is

$w_1 = 0.5, w_2 = 1.0, w_3 = 2.0, b = 0.0$

Much Better

```python
# multivariable_lr_gd_matrix.py
import numpy as np

data = np.array([[3.9,2.1,7.5,19.05],
                 [2.1,3.2,4.5,13.25],
                 [4.7,4.1,7.8,22.05],
                 [8.5,5.4,1.2,12.05],
                 [1.9,3.4,6.2,16.75],
                 [6.3,4.3,7.7,22.85],
                 [8.9,4.4,3.3,15.45]])
x = data[:, :-1]
y = data[:, -1]

# initialization
w = np.array([0, 0, 0])
b = 0
# learning rate
alpha = 0.01
# GD
for i in range(50000):
    w = w - alpha * (1 / len(data)) * np.dot(np.transpose(np.dot(x, w)+b - y), x)
    b = b - alpha * (1 / len(data)) * sum(np.dot(x, w)+b - y)
print(w, b)
```

Lab 46

Train a linear model (estimate optimal w_1, w_2, w_3, b) given the data below.
The answer is $\mathbf{w_1 = 1.0, w_2 = 2.0, w_3 = 3.0, b = 1.0}$.
Submit both source codes and screenshots in the blackboard.

x_1	x_2	x_3	y
3.5	4.7	2.3	20.8
4.4	5.7	4.1	29.1
2.5	7.3	1.2	21.7
8.5	3.3	4.8	30.5
4.9	6.4	5.7	35.8
7.2	7.1	7.4	44.6
5.6	8.2	6.5	42.5