

Linear Regression Homework

Delta Rule Update

Initial Weights:

- $(w_1 = 0)$
- $(w_2 = 0)$
- $(b = 0)$

Learning Rate: $(\eta = 0.2)$

Training Set:

(x_1)	(x_2)	Target
0.3	0.8	0.7
-0.3	1.6	-0.1
0.9	0	1.3

Delta Rule Update

1. First Sample $((x_1 = 0.3), (x_2 = 0.8), \text{Target} = 0.7)$

- **Output Calculation:**

$$y = w_1 \times 0.3 + w_2 \times 0.8 + b = 0 \times 0.3 + 0 \times 0.8 + 0 = 0$$

- **Error:**

$$\delta = \text{Target} - y = 0.7 - 0 = 0.7$$

- **Weight Updates:**

$$w_1 = 0 + 0.2 \times 0.7 \times 0.3 = 0.042$$

$$w_2 = 0 + 0.2 \times 0.7 \times 0.8 = 0.112$$

$$b = 0 + 0.2 \times 0.7 \times 1 = 0.14$$

2. Second Sample (($x_1 = -0.3$), ($x_2 = 1.6$), Target = -0.1)

- **Output Calculation:**

$$y = 0.042 \times (-0.3) + 0.112 \times 1.6 + 0.14 = -0.0126 + 0.1792 + 0.14 = 0.3066$$

- **Error:**

$$\delta = \text{Target} - y = -0.1 - 0.3066 = -0.4066$$

- **Weight Updates:**

$$w_1 = 0.042 + 0.2 \times (-0.4066) \times (-0.3) = 0.042 + 0.024396 = 0.066396$$

$$w_2 = 0.112 + 0.2 \times (-0.4066) \times 1.6 = 0.112 - 0.130112 = -0.018112$$

$$b = 0.14 + 0.2 \times (-0.4066) \times 1 = 0.14 - 0.08132 = 0.05868$$

3. Third Sample (($x_1 = 0.9$), ($x_2 = 0$), Target = 1.3)

- **Output Calculation:**

$$y = 0.066396 \times 0.9 + (-0.018112) \times 0 + 0.05868 = 0.0597564 + 0 + 0.05868 = 0.1184364$$

- **Error:**

$$\delta = \text{Target} - y = 1.3 - 0.1184364 = 1.1815636$$

- **Weight Updates:**

$$w_1 = 0.066396 + 0.2 \times 1.1815636 \times 0.9 = 0.066396 + 0.212681248 = 0.279077$$

$$w_2 = -0.018112 + 0.2 \times 1.1815636 \times 0 = -0.018112$$

$$b = 0.05868 + 0.2 \times 1.1815636 \times 1 = 0.05868 + 0.23631272 = 0.295$$

Updated Weights After One Iteration

- ($w_1 \approx 0.2791$)
- ($w_2 \approx -0.0181$)
- ($b \approx 0.295$)

Generalization for Novel Input ((x_1 = 1), (x_2 = 0.5))

- **Output Calculation:**

$$y = 0.2791 \times 1 + (-0.0181) \times 0.5 + 0.295 = 0.2791 - 0.00905 + 0.295 = 0.56505$$

- **Predicted Output:** ($y \approx 0.565$)