Intelligent Systems: Reasoning and Recognition

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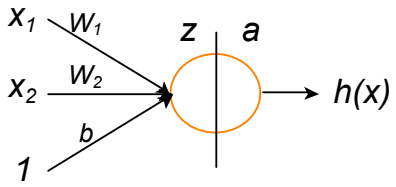
MoSIG M1 Practice Exam

2) (6 points) You are presented with a single neuron with two inputs (X_1, X_2) and a single output a computed using a sigmoid ($F(z) = \sigma(z)$). Your network has been initialized with weights $W_1 = -0.5$ and $W_2 = +0.2$ and $b = 0.5$. Assume a learning rate of $\eta = 0.5$.



Your network should be trained to recognize the following training data:

m	x_1	x_2	y_m
1	1	0	0
2	0	1	0
3	0	0	1
4	1	1	1

a) Compute z, and a for $m=1$.

$$z = -0.5 \cdot X_1 + 0.2 \cdot X_2 + 0.4 = -0.5 + 0.5 = 0$$
$$a = f(z) = \sigma(0) = 0.5$$

b) Compute $\delta_m^{(2)} = h(X_m) - y_m$ for $m=1$

$$\delta_1^{(2)} = h(X_1) - y_1 = 0.5 - 0 = 0.5$$

c) Compute $\delta_m^{(1)}$ for $m=1$

$$\delta_m^{(1)} = a_m^{(1)}(1 - a_m^{(1)}) \cdot \delta_m^{(2)} = 0.5 \cdot 0.5 \cdot 0.5 = 0.125$$

d) Compute ΔW_1, ΔW_2, and Δb for $m=1$

$$\Delta w_1^{(1)} = X_1 \delta_m^{(1)} = 1 \cdot (0.125) = 0.125$$
$$\Delta w_2^{(1)} = X_2 \delta_m^{(1)} = 0$$
$$\Delta b_m = \delta_m^{(1)} = 0.125$$

e) Update W_1, W_2, and b for $m=1$.

$$W_1 \leftarrow W_1 - \eta \Delta W_1 = -0.5 - (0.5) \cdot 0.125 = -0.5625$$
$$W_2 \leftarrow W_2 - \eta \Delta W_2 = 0.2 + 0 = 0.2$$
$$b \leftarrow b - \eta \Delta b_m = 0.5 - 0.5 \cdot 0.125 = 0.4375$$

f) Will your neuron converge for this training data?

No. There is no linear surface that can separate the training data (Not-XOR)