Machine Learning – Written Assignment 3

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1.

2.

3.

4. 1. With inputs $x_1 = 0.5$ and $x_2 = 0.9$, we have the following values for the first and only hidden layer nodes:

$$a_1 = \frac{1}{1 + e^{-(0.2+0.5 \cdot 0.5+0.5 \cdot 0.9)}} = 0.710949502625$$
$$a_2 = \frac{1}{1 + e^{-(0.2+0.5 \cdot 0.1+0.9 \dot{0}.7)}} = 0.706822221094$$

   Finally, we have the value for the output layer:

$$a_{\text{output}} = \frac{1}{1 + e^{0.2+0.710949502625+0.706822221094 \cdot 2}} = 0.910893519678$$

   2.

$$\delta_1^{(3)} = y^{(3)} - a_1^{(3)} = 1 - 0.910893519678 = 0.089106480322$$
$$\delta_1^{(2)} = y^{(2)} - a_1^{(2)} = 0.089106480322 \cdot 2 = 0.178212960644$$
$$\delta_2^{(2)} = y^{(2)} - a_2^{(2)} = 0.089106480322 \cdot 1 = 0.089106480322$$

5. 1. The values of $w_0 = -1$, $w_1 = 1$ and $w_2 = 1$ refer to the weights of the connections.

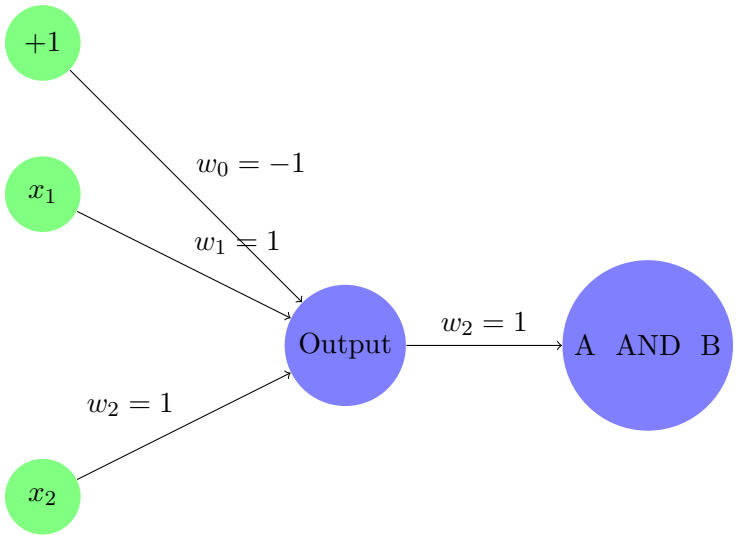
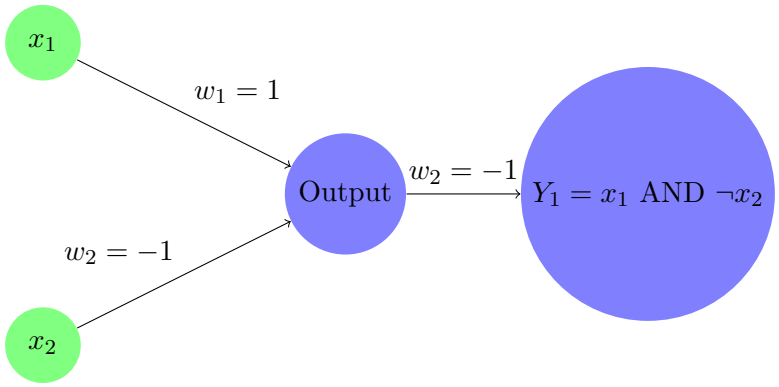
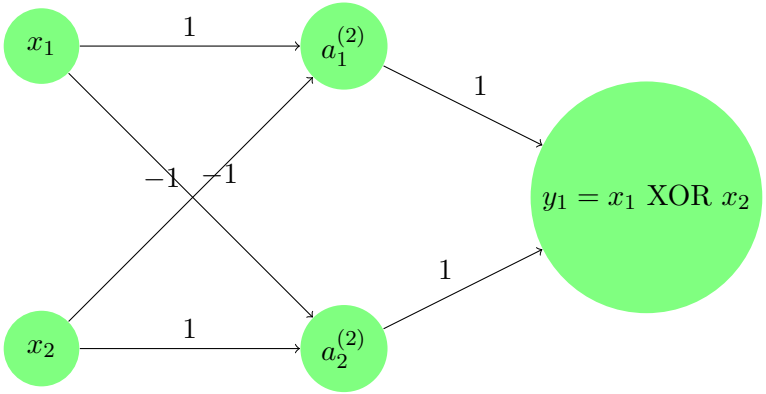


Figure 1: A AND B

   2. a. We don't require a bias neuron. $w_1 = 1$ and $w_2 = -1$.
      b. A XOR B.


x_1
$w_1 = 1$
Output
$w_2 = -1$
$Y_1 = x_1$ AND $\neg x_2$
$w_2 = -1$
x_2


x_1
1
$a_1^{(2)}$
1
-1
-1
$y_1 = x_1$ XOR x_2
1
x_2
1
$a_2^{(2)}$