Q1, $\begin{cases} w_0 b + w_1 x_1 + w_2 x_2 = 0 \\ \dfrac{x_1 - (-1)}{0 - (-1)} = \dfrac{x_2 - 0}{2 - 0} \end{cases} \Rightarrow x_1 + 1 = \dfrac{x_2}{2} \Rightarrow 2x_1 + 2 = x_2,$

$\Rightarrow 2x_1 - x_2 + 2 = 0,$ 这是其中一个解.

so, $w_0 = 1, w_1 = 2, w_2 = -1,$ $b = 2$

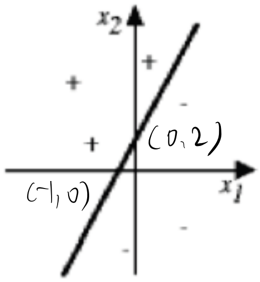
注：上式为两点直线方程, $\dfrac{x - x_1}{x_2 - x_1} = \dfrac{y - y_1}{y_2 - y_1}$, 将 x_2 看作 y

INT301 Bio-computation

Week 6 Tutorial

Question 1.

Suggest values of weights w0, w1, and w2 for the perceptron whose decision surface is illustrated in the figure (the surface crosses the x1 axis at -1 and the x2 axis at 2).



Question 2. Q2, open question

Design a neural network with sigmoid units to predict a person's academic role from his webpage. Possible roles are "professor", "student", "staff". However, each person can take any number (from 0 to all 3) of these roles at the same time. Briefly describe:

(1) How you would represent the role label of a person in your training data;

(2) Suggest a possible threshold value for the outputs.

Question 3.

The neural network in the figure can be used to distinguish between nails and screws. The training samples in format {(neuro 1, neuron 2), (neuron 6, neuron 7)} are provided as follows: T1{(0.6, 0.1), (1, 0)}, T2{(0.2, 0.3), (0, 1)}, where (1, 0) represents nail and (0, 1) represents screw. Fix the learning rate as 0.1 and initialize the network with the weights indicated in the figure (the bias are given next to the nodes). Show the detailed process of both forward propagation and back propagation in the network using T1 as input.

Q3:

Forward pass:

$O_j = \sigma(S_j) = \dfrac{1}{1+e^{-S_j}}, \quad S_j = \sum_{i=0}^{d} w_{ij} O_i$

$S_3 = w_{13} \times O_1 + w_{23} \times O_2 + b_3$

$= 0.1 \times 0.6 + (-0.2) \times 0.1 + 0.1 = 0.14$

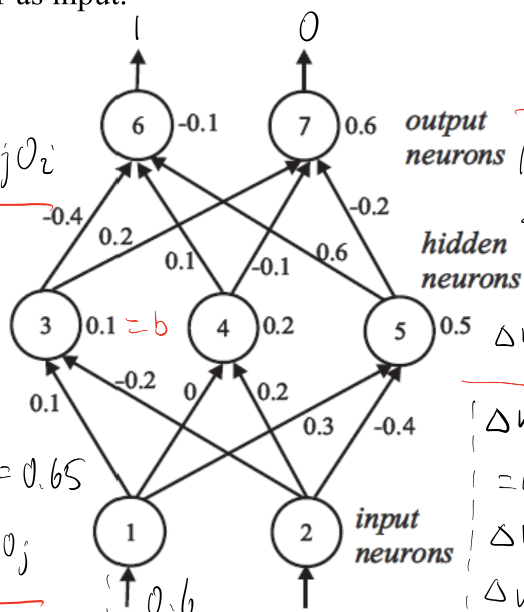
$S_4 = 0.22 \quad S_5 = 0.64$

$O_3 = \dfrac{1}{1+e^{-0.14}} = 0.53, \; O_4 = 0.55, \; O_5 = 0.65$

$O_k = \sigma(S_k) = \dfrac{1}{1+e^{-S_k}}, \quad S_k = \sum_{i=0}^{d} w_{jk} O_j$

$S_6 = w_{36} \times O_3 + w_{46} \times O_4 + w_{56} \times O_5 + b_6 = 0.13$

$S_7 = 0.52, \quad O_6 = 0.53, \quad O_7 = 0.63$



backward pass:

$\beta_k = O_k(1 - O_k)[y_k - O_k]$

$\beta_6 = O_6(1 - O_6)[y_6 - O_6]$

$= 0.53(1 - 0.53)[1 - 0.53] = 0.12$

$\beta_7 = -0.15$

$\Delta w_{jk} = \eta \beta_k O_j, \quad \Delta w_{0k} = \eta \beta_k$

$\Delta w_{36} = b_3 \times \beta_6 \times O_3$

$= 0.1 \times 0.12 \times 0.53 = 0.006,$

$\Delta w_{37} = -0.008,$

$\Delta w_{0b} = \Delta w_{b6} = \eta \beta_6 = 0.1 \times 0.12 = 0.012$