Perceptron Algorithm

- **Initialisation**
  - set all of the weights w_{ij} to small (positive and negative) random numbers
- **Training**
  - for T iterations or until all the outputs are correct:
    * for each input vector:
      - compute the activation of each neuron j using activation function g:

$$y_j = g\left(\sum_{i=0}^{m} w_{ij}x_i\right) = \begin{cases} 1 & \text{if } \sum_{i=0}^{m} w_{ij}x_i > 0 \\ 0 & \text{if } \sum_{i=0}^{m} w_{ij}x_i \le 0 \end{cases} \quad (3.4)$$

      - update each of the weights individually using:

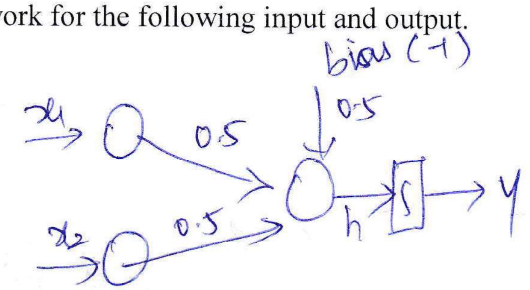
$$w_{ij} \leftarrow w_{ij} - \eta(y_j - t_j)\cdot x_i \quad (3.5)$$

- **Recall**
  - compute the activation of each neuron j using:

$$y_j = g\left(\sum_{i=0}^{m} w_{ij}x_i\right) = \begin{cases} 1 & \text{if } w_{ij}x_i > 0 \\ 0 & \text{if } w_{ij}x_i \le 0 \end{cases} \quad (3.6)$$

4. b. Identify the suitable weights for the AND network for the following input and output.

X_1	X_2	T
1	1	1
-1	1	-1
1	-1	-1
-1	-1	-1



Where w0 = w1 = w2 = 0.5, eta = 0.1, bias = -1

Find the updated weight of each sample for one Epoch.

Assume $\theta = 0$

$$y = \begin{cases} 1 & h \geq 0 \\ -1 & h \leq 0 \end{cases}$$

Epoch I

(1,1)

$h = \text{bias} \times w_0 + x_1 \times w_1 + x_2 \times w_2$

$= -1 \times 0.5 + 1 \times 0.5 + 1 \times 0.5$

$= 0.5 \qquad h > 0 \quad \therefore \ y = 1$

$w_0(\text{new}) = w_0(\text{old}) + \eta(T - y)x$

$= 0.5 + 0.1(1-1)(-1) = 0.5$

$\boxed{w_0 = w_1 \ w_2 = 0.5}$

(-1,1)

$h = -1 \times 0.5 + (-1) \times 0.5 + 1 \times 0.5$

$= -0.5 - 0.5 + 0.5 = -0.5 < 0 \quad \therefore \ y = -1$

$w_0 = 0.5 + 0.1(-1+1)(-1) = 0.5$

$\boxed{w_0 = w_1 = w_2 = 0.5}$

(1, -1)

$h = (-1) \times 0.5 + 1 \times 0.5 + (-1) \times 0.5)$

$= -0.5 + 0.5 - 0.5 = -0.5 \leq 0 \therefore \underline{y = -1}$

$w_0 = 0.5 + 0.1(-1+1)(-1) = 0.5$

$\boxed{w_0 = w_1 = w_2 = 0.5}$

(-1, -1)

$h = (-1) \times 0.5 + (-1) \times 0.5 + (-1) \times 0.5)$

$= -0.5 + (-0.5) + (-0.5) = -1.5 \leq 0 \therefore \underline{y = -1}$

$w_0 = 0.5 + 0.1(-1+1)(-1) = 0.5$

$\boxed{w_0 = w_1 = w_2 = 0.5}$

x_1	x_2	T	h	y	w_0	w_1	w_2
1	1	1	0.5	1	0.5	0.5	0.5
-1	1	-1	-0.5	-1	0.5	0.5	0.5
1	-1	-1	-0.5	-1	0.5	0.5	0.5
-1	-1	-1	-1.5	-1	0.5	0.5	0.5