Perceptron

- Supervised learning algorithm
- Binary classifiers

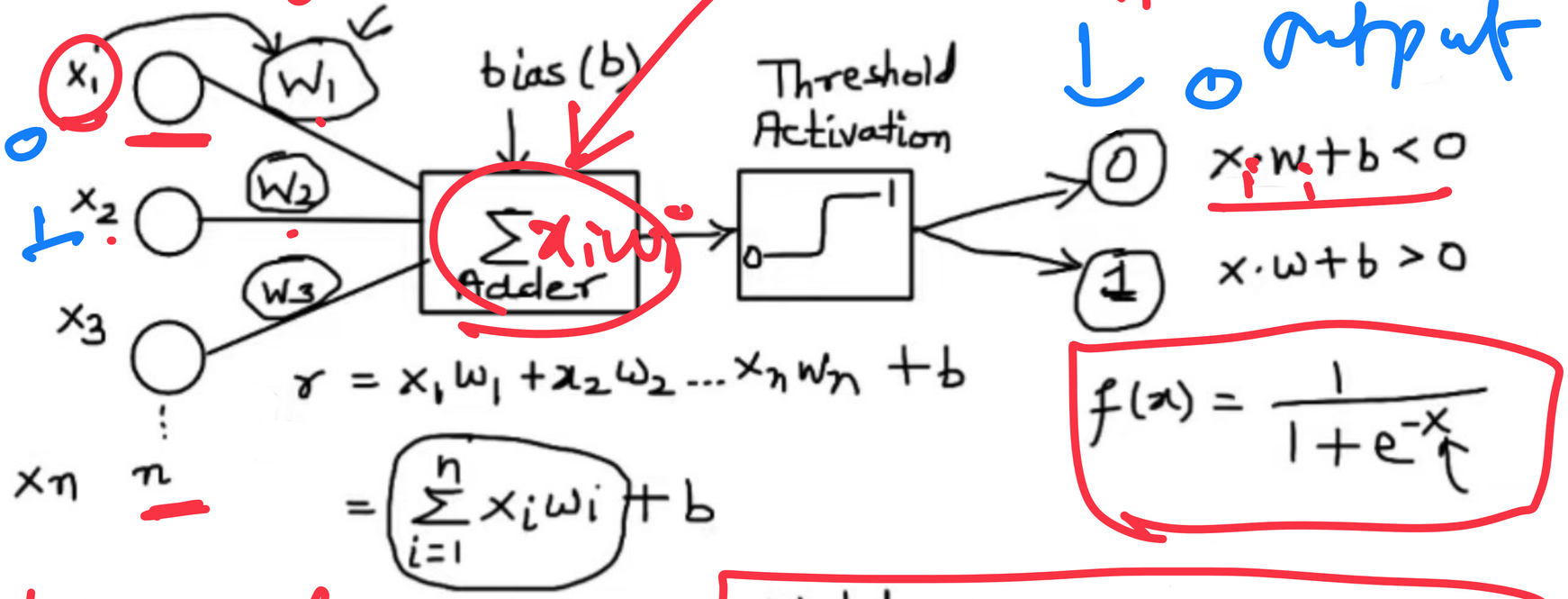
$w_1 \geq 1$
$w_2 \geq 0.5$

α learning rate

Activation function

Neural network

ANN



$$X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \quad W = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix}$$

Input

Weights

corresponding wt.

$$\gamma = x_1 w_1 + x_2 w_2 \ldots x_n w_n + b$$

$$= \sum_{i=1}^{n} x_i w_i + b$$

$$f(x) = \frac{1}{1 + e^{-x}}$$

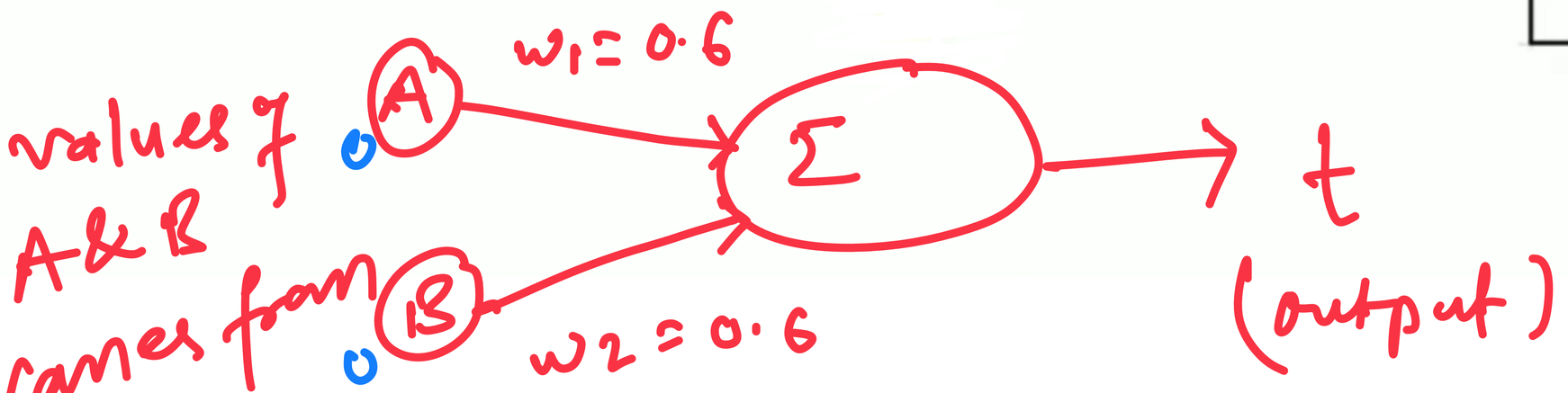
Update

$$W_{new} = W_{old} + \alpha(t - o)$$

Logical OR gate using Perreptorn

w1 = 0.6, w2 = 0.6 Threshold = 1 and Learning Rate n = 0.5

A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

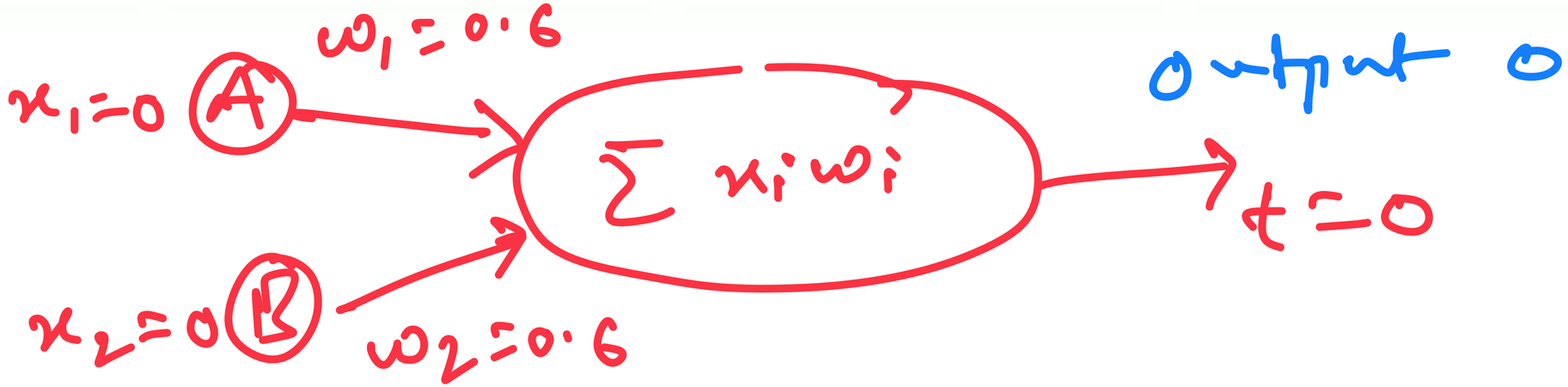


w1 = 0.6, w2 = 0.6 Threshold = 1 and Learning Rate n = 0.5

A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

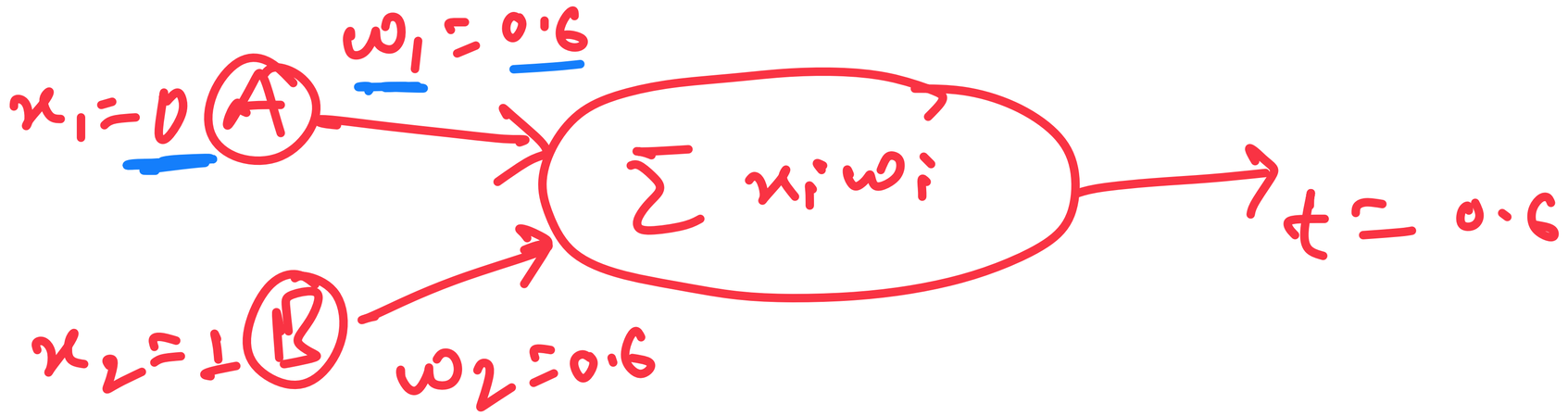
1. A=0, B=0 and Target = 0

- $\sum wi.xi = 0*0.6 + 0*0.6 = 0$
- This is not greater than the threshold of 1, so the output = 0



2. A=0, B=1 and Target = 1

- *wi.xi = 0*0.6 + 1*0.6 = 0.6*
- This is not greater than the threshold of 1, so the output = 0



updates:

$$wi = wi + n(t - o)xi$$

$$w1 = 0.6 + 0.5(1 - 0)0 = 0.6$$

$$w2 = 0.6 + 0.5(1 - 0)1 = 1.1$$

$w_1 = 0.6, w_2 = 1.1$

A = 0, B = 0 T = 0

w1 = 0.6, w2 = 1.1 Threshold = 1 and Learning Rate n = 0.5

A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

1. A=0, B=0 and Target = 0
   - *wi.xi = 0*0.6 + 0*1.1 = 0*
   - This is not greater than the threshold of 1, so the output = 0
2. A=0, B=1 and Target = 1
   - *wi.xi = 0*0.6 + 1*1.1 = 1.1*
   - This is greater than the threshold of 1, so the output = 1

3. A = 1, B = 0, T = 1 $w_1 = 0.6$, $w_2 = 1.1$, $\eta = 0.5$

$$w_i = w_i + \eta(t-o)x_i$$

w1 = 0.6, w2 = 1.1 Threshold = 1 and Learning Rate n = 0.5

A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

3. A=1, B=0 and Target = 1

- *wi.xi = 1*0.6 + 0*1.1 = 0.6*
- This is not greater than the threshold of 1, so the output = 0

$$wi = wi + n(t - o)xi$$

$$w1 = 0.6 + 0.5(1 - 0)1 = 1.1$$

$$w2 = 1.1 + 0.5(1 - 0)0 = 1.1$$

w1 = 1.1, w2 = 1.1 Threshold = 1 and Learning Rate n = 0.5

A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

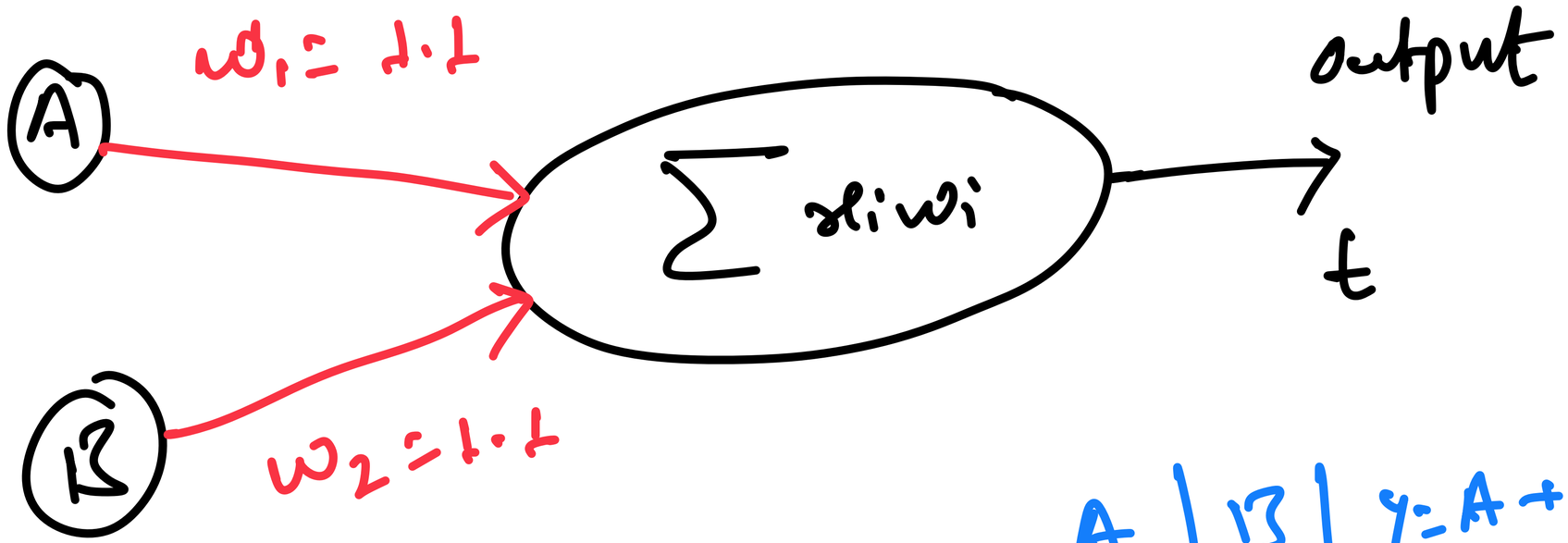
1. A=0, B=0 and Target = 0
   - *wi.xi = 0*1.1 + 0*1.1 = 0*
   - This is not greater than the threshold of 1, so the output = 0
2. A=0, B=1 and Target = 1
   - *wi.xi = 0*1.1 + 1*1.1 = 1.1*
   - This is greater than the threshold of 1, so the output = 1

w1 = 1.1, w2 = 1.1 Threshold = 1 and Learning Rate n = 0.5

A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

3. A=1, B=0 and Target = 1
   - *wi.xi = 1*1.1 + 0*1.1 = 1.1*
   - This is greater than the threshold of 1, so the output = 1
4. A=1, B=1 and Target = 1
   - *wi.xi = 1*1.1 + 1*1.1 = 2.2*
   - This is greater than the threshold of 1, so the output = 1

Finally,



A	B	y = A + B
0	0	0
0	1	1
1	0	1
1	2	1

Single layer & Multi layer Neural network

Implement the logical AND gate using Single layer neural network.

Assume

w_1, w_2, threshold & learning rate of your own.

A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1