

The activation functions used by the Neuron Class are given below. Let the output be represented by:

$$O_i = g \left( \sum_j w_{ji} O_j \right) = g(h_i)$$

Where  $O_i$  is the output of Neuron  $i$ ,  $g(x)$  is the *activation function*,  $w_{ji}$  is the value of the weight connecting the output of Neuron  $j$  to the input of Neuron  $i$  and  $h_i$  is the net input to Neuron  $i$  given by the summation in the above equation.

The activation functions,  $g(x)$ , are given by:

- Binary ( $T = 0$ )

$$O_i = \begin{cases} 1.0, & \text{if } h_i > 0.0 \\ 0.0, & \text{if } h_i < 0.0 \end{cases}$$

- Binary ( $T > 0$ )

$$O_i = \begin{cases} 1.0, & \text{if } rnd \leq \left(1 + e^{-2h_i/T}\right)^{-1} \\ 0.0, & \text{otherwise} \end{cases}$$

- Sigmoid

$$O_i = \frac{1}{1 + e^{-h_i}}$$

- Sign ( $T = 0$ )

$$O_i = \text{sgn}(h_i)$$

- Sign ( $T > 0$ )

$$O_i = \begin{cases} 1.0, & \text{if } rnd \leq \left(1 + e^{-2h_i/T}\right)^{-1} \\ -1.0, & \text{otherwise} \end{cases}$$

- Tanh

$$O_i = \begin{cases} \tanh(h_i), & \text{if } T = 0 \\ \tanh(h_i/T), & \text{if } T > 0 \end{cases}$$

NOTE:  $rnd$  is a random number between 0 and 1.