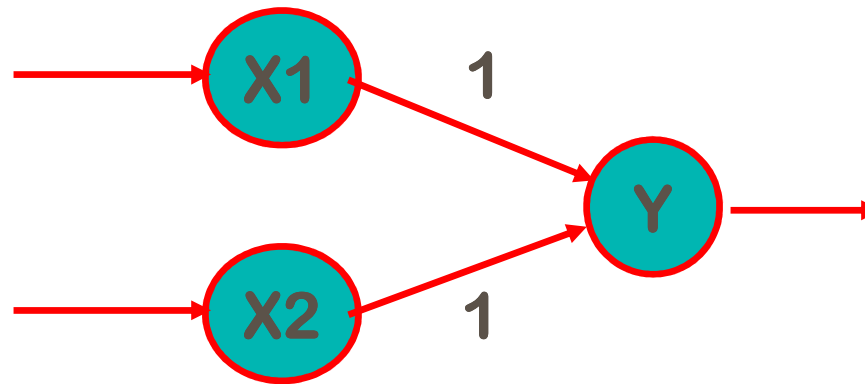
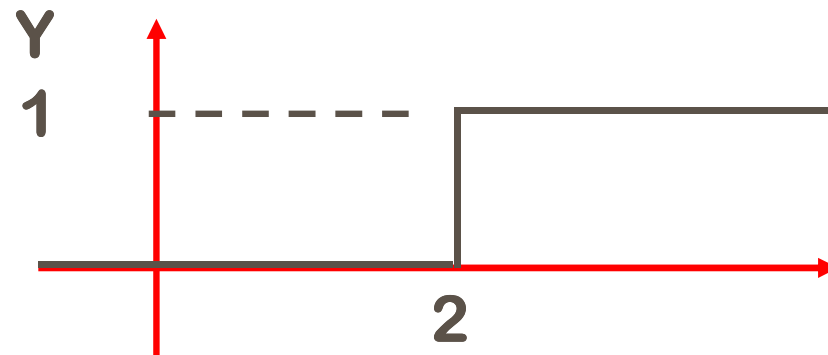


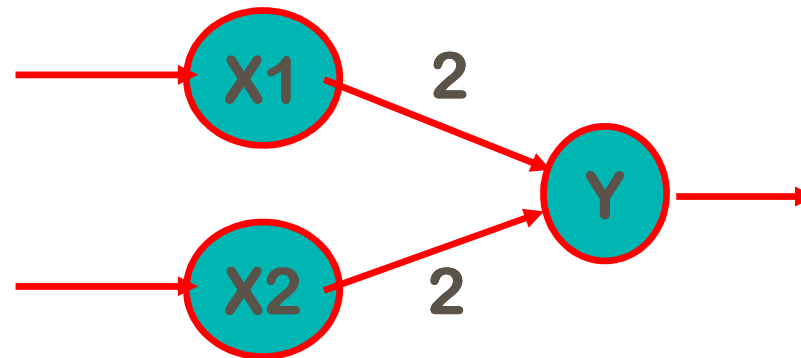
1st Neural Network: AND function



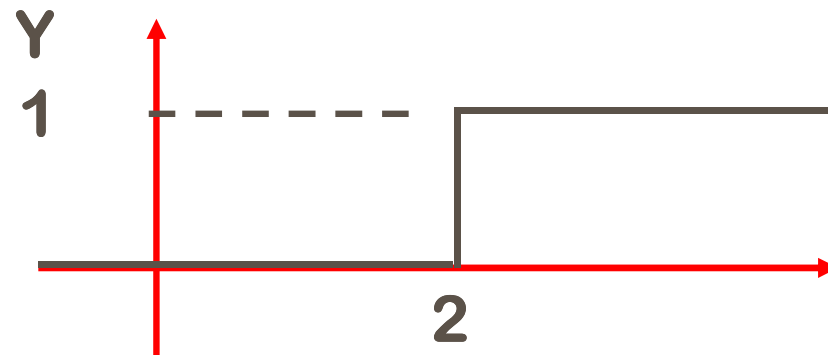
Threshold(Y) = 2



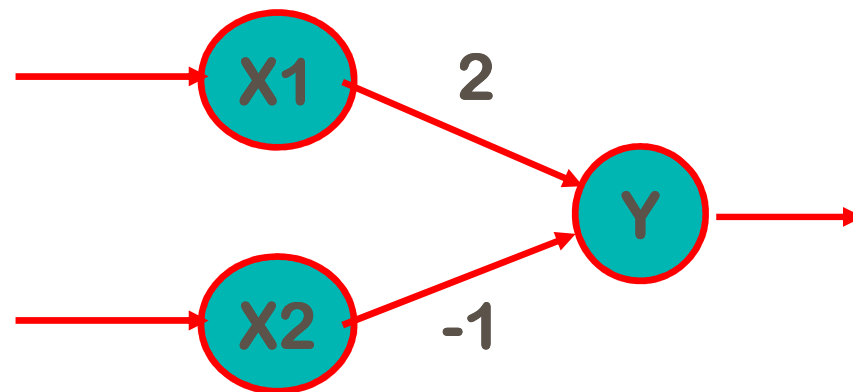
1st Neural Network: OR function



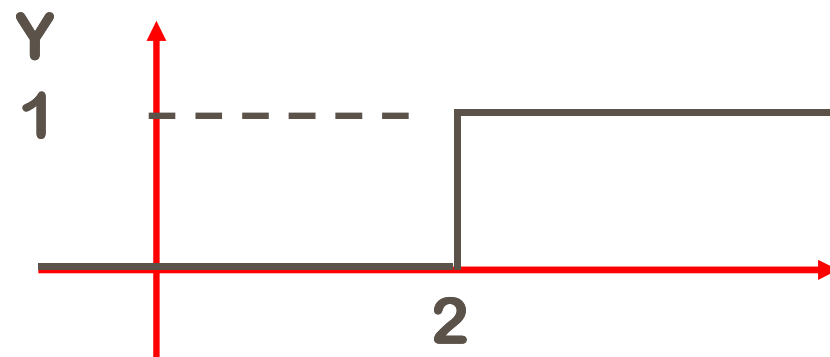
Threshold(Y) = 2



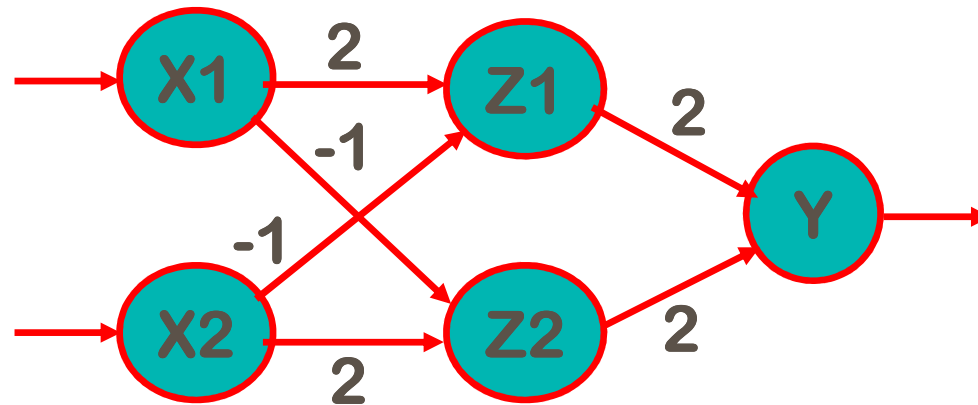
1st Neural Network: AND not function



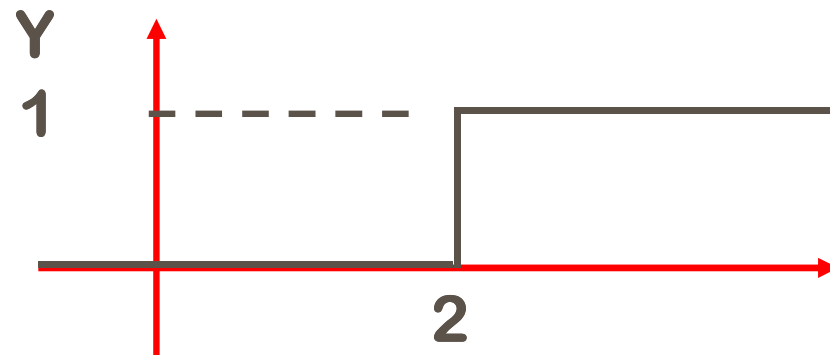
Threshold(Y) = 2



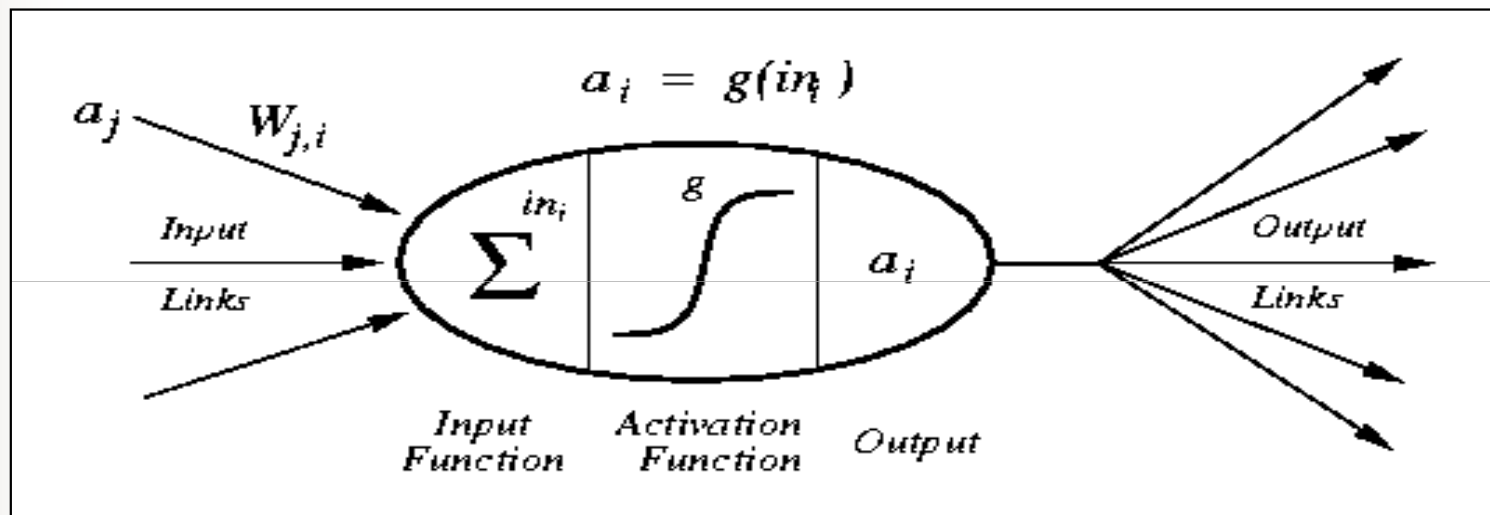
1st Neural Network: XOR function



Threshold(Y) = 2



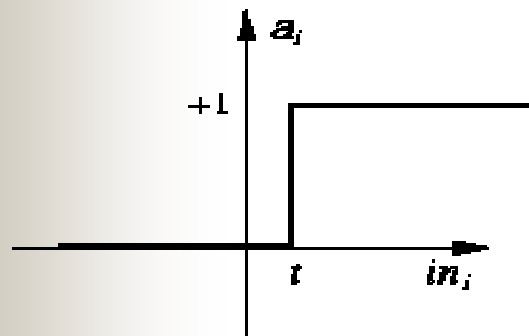
Modeling a neuron



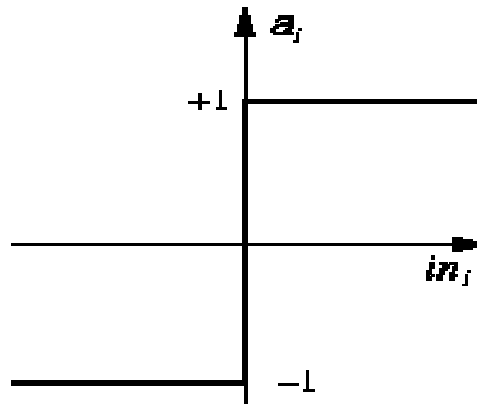
- a_j :Activation value of unit j
- $w_{j,i}$:Weight on the link from unit j to unit i
- in_i :Weighted sum of inputs to unit i
- a_i :Activation value of unit i
- g :Activation function

$$in_i = \sum_j W_{j,i} a_j$$

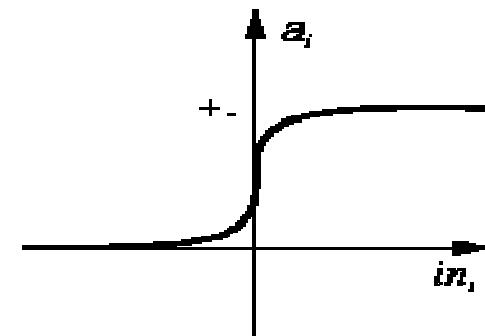
Activation Function



(a) Step function



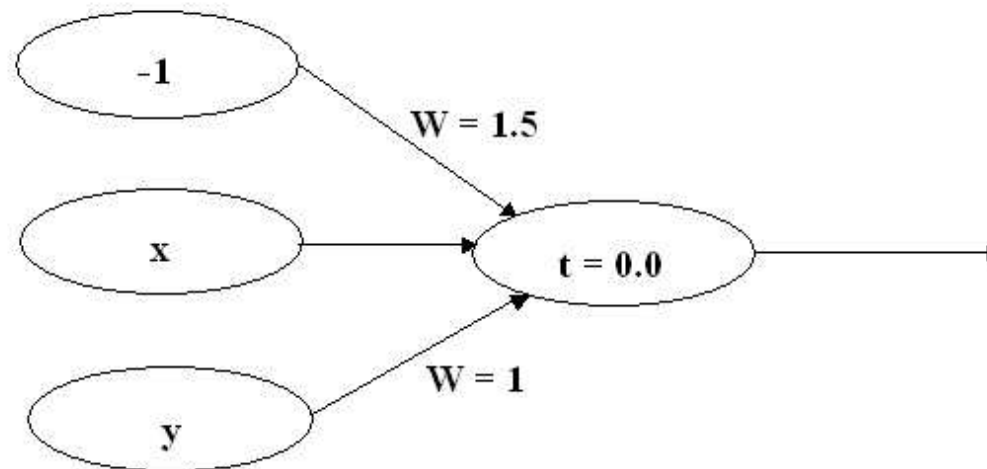
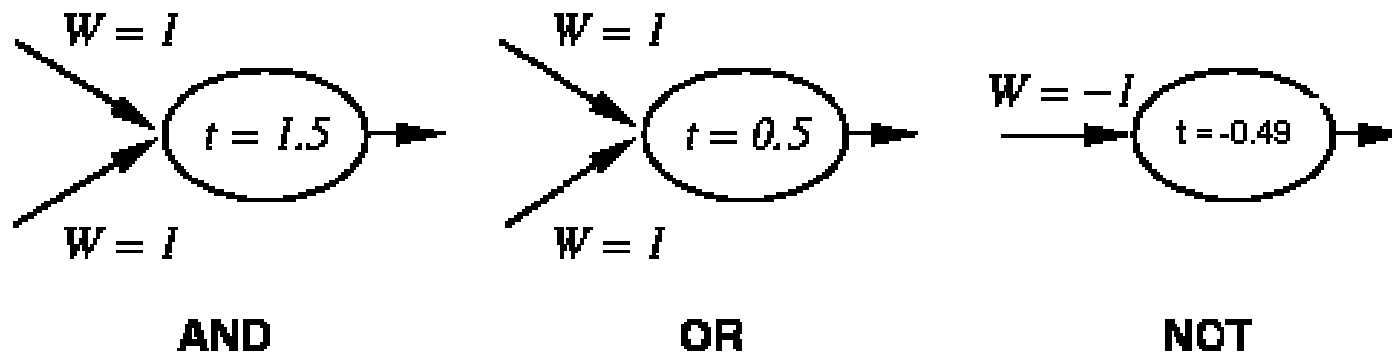
(b) Sign function

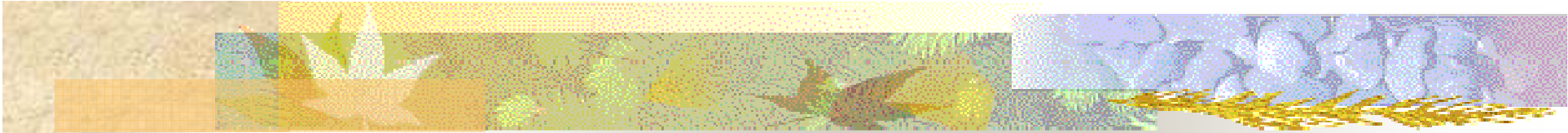


(c) Sigmoid function

- $\text{Step}_t(x) = 1 \text{ if } x \geq t, \text{ else } 0$
- $\text{Sign}(x) = +1 \text{ if } x \geq 0, \text{ else } -1$
- $\text{Sigmoid}(x) = 1/(1+e^{-x})$

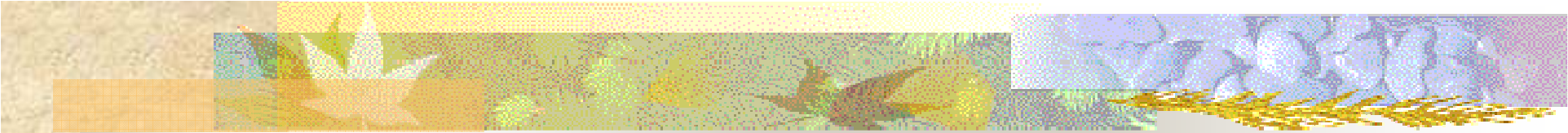
Simple Network





Learning (training)

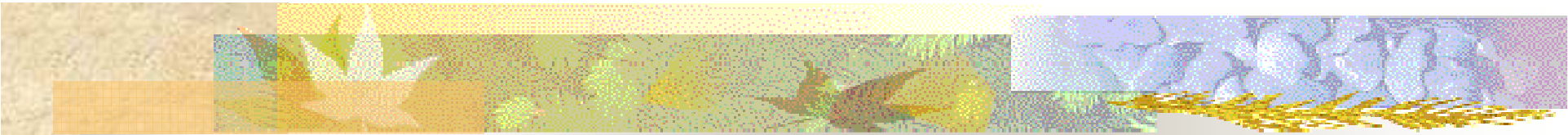
Learning in ANN is adjusting the connection weight between neurons. Knowledge is stored in this weight matrices.



Training Methods

- Unsupervised Learning (learning without teacher or learning by doing)
- Supervised Learning (learning with teacher)
- Back propagation

It's similar to Supervised Learning but the error signal is used to adjust the weight.



Simple Training

While (epoch produces an error) {

 // give the next input

 Error = Target – Output;

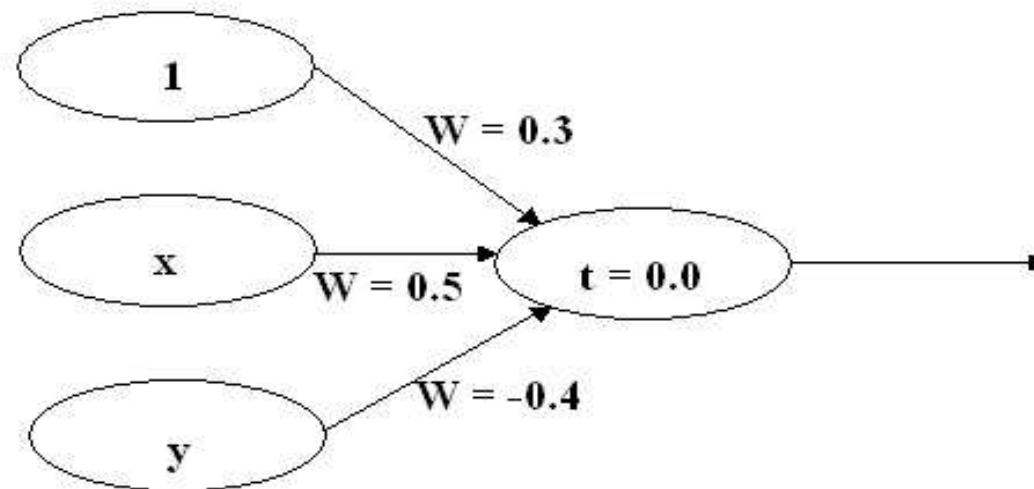
 If (Error <> 0)

$\text{Weight}_{j+1} = \text{Weight}_j + \text{LearningRate} * \text{Input}_j * \text{Error};$

 }

Epoch : Presentation of the entire training set to the neural network.

Example

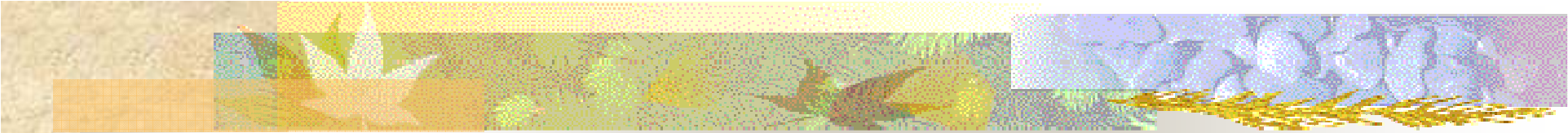


Input X

Input Y

Output

AND			
0	0	1	1
0	1	0	1
0	0	0	1



ANN Design:

- How to arrange neurons in various layers
- How to connect neuron from different layer
- How the neurons get input(s) and give result(s)
- Learning rate value
- Using bias or not
- How to train the ANN

Applications:

- Prediction

- Currency, stock exchange, weather, etc.

- Classification

- Pattern, shape, etc.

