

Neural Networks

- Homework 3 -

Petr Lukin, Ivan Vishniakou, Evgeniya Ovchinnikova

Lecture date: 17 October 2016

1 Exercises

1.1 Exercise 2.1

The delta rule described in the following equation:

$$\Delta w_{kj}(n) = \eta e_k(n) x_j(n)$$

and Hebb's rule described in:

$$\Delta w_{kj}(n) = \eta y_k(n) x_j(n)$$

represent the two different methods of learning. List the features that distinguish these two rules from each other.

Solution:

- Learning rule: delta rule is a part of error-correction learning, whereas Hebb's rule is a part of memory-based learning.
- Adjustment: in delta rule it is based on the difference between desired and actual output (the error) and in Hebb's rule - on correlation, whether two neurons connected by synapse that is being considered are activated simultaneously or not.
- Learning paradigm: delta rule - supervised learning, Hebb's rule - unsupervised learning.
- Saturation

1.2 Exercise 2.10

Formulate the expression for the output y_j of neuron j in the network of Fig. 1, where:

$x_i = i^{th}$ input signal,

w_{ji} = synaptic weight from input i to neuron j ,

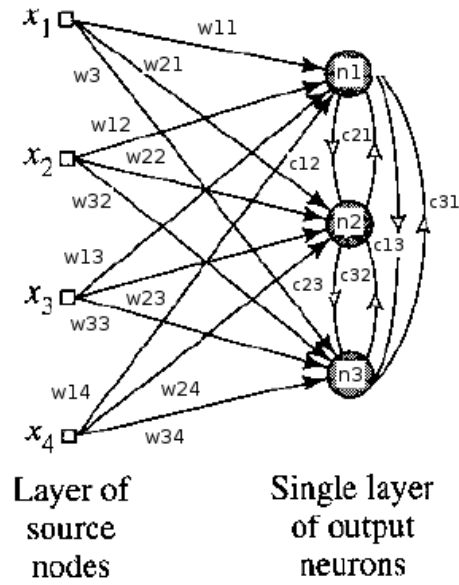
c_{kj} = weight of lateral connection from neuron k to neuron j ,

$y_j = \phi(v_j)$.

What is the condition that would have to be satisfied for neuron j to be the winning neuron?

Solution:

Figure 1: Competitive neural network with feedforward connections.



$$y_j = \phi\left(\sum_{i=1}^4 w_{ji}x_i + \sum_{k=1, k \neq j}^3 c_{kj}y_k\right) = \phi\left(\sum_{i=1}^4 w_{ji}x_i + \sum_{k=1, k \neq j}^3 c_{kj}\phi(v_k)\right)$$

, where k_1, k_2 are numbers from 1 to 3 those are not equal j .

Neuron j is a winning neuron if $v_j > v_k$ for all $k \neq j$.