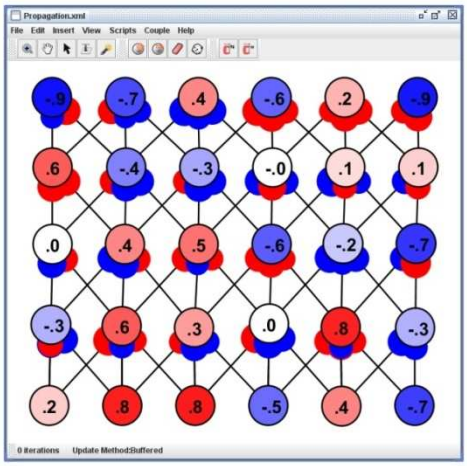
For this lab we will not assume any knowledge of the mathematics of neural networks. The goal is simply to play with a neural network and get a sense of the way they channel information, the impacts of changing inputs and weights, and at a very broad level, the structure of "learning as synaptic modification".

Begin by going to **File** --> **Open Network** and select **Propagation.**xml in the folder called "labs". You should see the following network.



Now try changing the bottom row of the neurons (which can be thought of as input neurons):

- Select bottom neurons using lasso or, alternatively, select neurons individually by holding **shift** and clicking on each of the six bottom neurons. (These bottom neurons that are now selected can be thought of as input neurons.)
- Randomize the neurons by pressing **R** or by pressing the **random button**
- Iterate the network to see activation propagate through the network's nodes, by pressing either **spacebar** or the **step button** repeatedly. You can also press the **play button** .
- Randomize the neurons again as described above and iterate the network through to see new network reactions.
- Alternatively, try pressing the **play button** and then repeatedly randomizing the bottom row of neurons.

Next play with changing **weights**:

- Be sure there is some activity (some color) in the bottom row of neurons.
- Now select all synapses by pressing the **W** button or using **Edit > Select > Select All Weights**.
- Randomize the weights using **R** or by clicking the **random button** above the network.
- Propagate the network using **spacebar** or clicking the **step button** repeatedly until network propagation can no longer be seen.
- Alternatively, press **play** and then repeatedly press the **random button** to see how this affects propagation of activity.

Finally, we modify the synapses so that they can change based on neural activity, which is how **learning** is modeled in neural networks:

- Select all weights by pressing **W** or using the menu **Edit > Select > Select All Weights.**
- Open the synapse dialog box by either double clicking on a synapse or using **Edit > Set 69 Selected Synapses** (if you "miss" you will have to reselect the synapses).
- Using the drop down box, select **Hebbian** from the list of synapse types and set learning rate to **0.1** (or, if you will be using the play button, try **0.01** or even **0.001 –** the smaller the learning rate the slower changes happen).
- Now select the bottom row of neurons as described above and randomize the neurons.
- Propagate activity using the **spacebar**, clicking on the **step button** repeatedly, or pressing **play**.
- Observe changes in the sizes of weights as activity propagates.
- Repeatedly randomize the neurons and observe changes in the weights.
- You can also repeatedly randomize the weights and observe how they change.

Exercises

1. Change all the weights back to **Clamped (no learning),** by pressing **W** and then going into the context menu. Then reset all weights and notes to 0, by accessing the weights via **W** and then clearing their values to 0 via **C**. Analogously with the nodes (**N + C**)**..**
2. Modify the network (i.e. the weights) so that, if the bottom row of nodes are all positive (red), the rest of the network will be all negative (blue). You can select multiple nodes and increase their activity with the arrow keys ↑.
3. Modify the network so that, if the bottom row is positive, alternate rows are negative and positive.