Dialog Processing with Neural Networks

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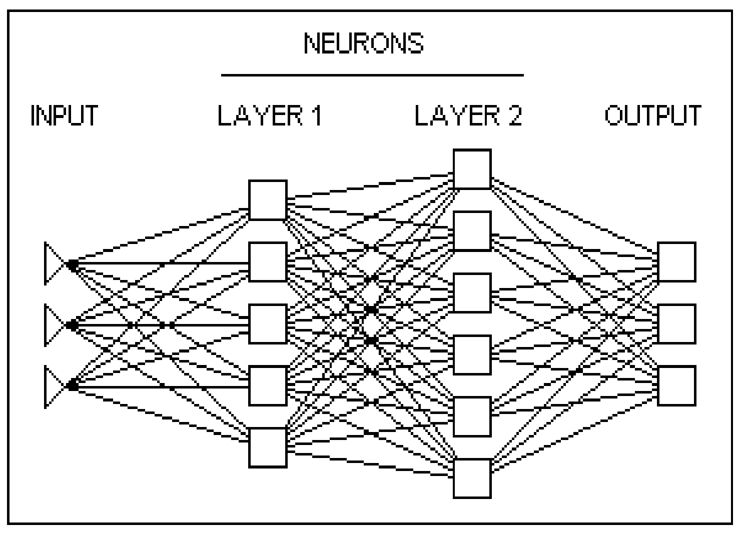
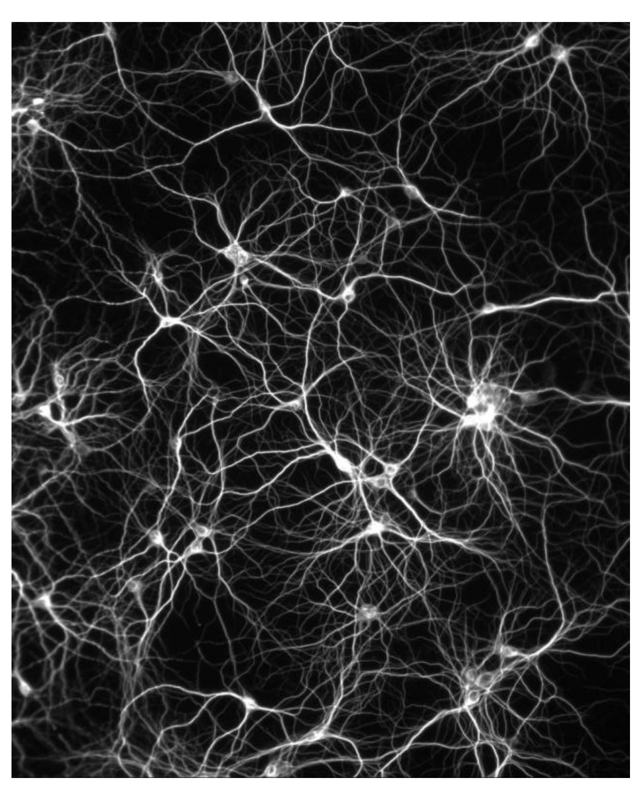


Outside of research, the neural networks used today are supervised, such that output for an input is matched against the right answer, and connections that produce the right answer are reinforced. The idea is that connections which have been right in the past will be right in the future.

However, I think that unsupervised neural networks have more promise for complex tasks. This is more analogous to the neurons within the brain. Instead of affecting the network in a series of supervised tests, the network is systematically modified as a series of inputs, such as words, are read in. In an attempt to mimic the brain, my network reinforces connections between nodes that often fire one after the other. In this case, each word is represented by a node.



However, it's not as simple as that. If the brain only noted connections between words, it wouldn't note connections to emotions or abstract ideas. In order to mimic these attributes of the brain, the ones that really think, nodes are added to the network that do not represent words. These take on meaning as they build connections to words and to each other. In time, they may let the network form complex ideas represented by nodes that have been influenced by the input text.

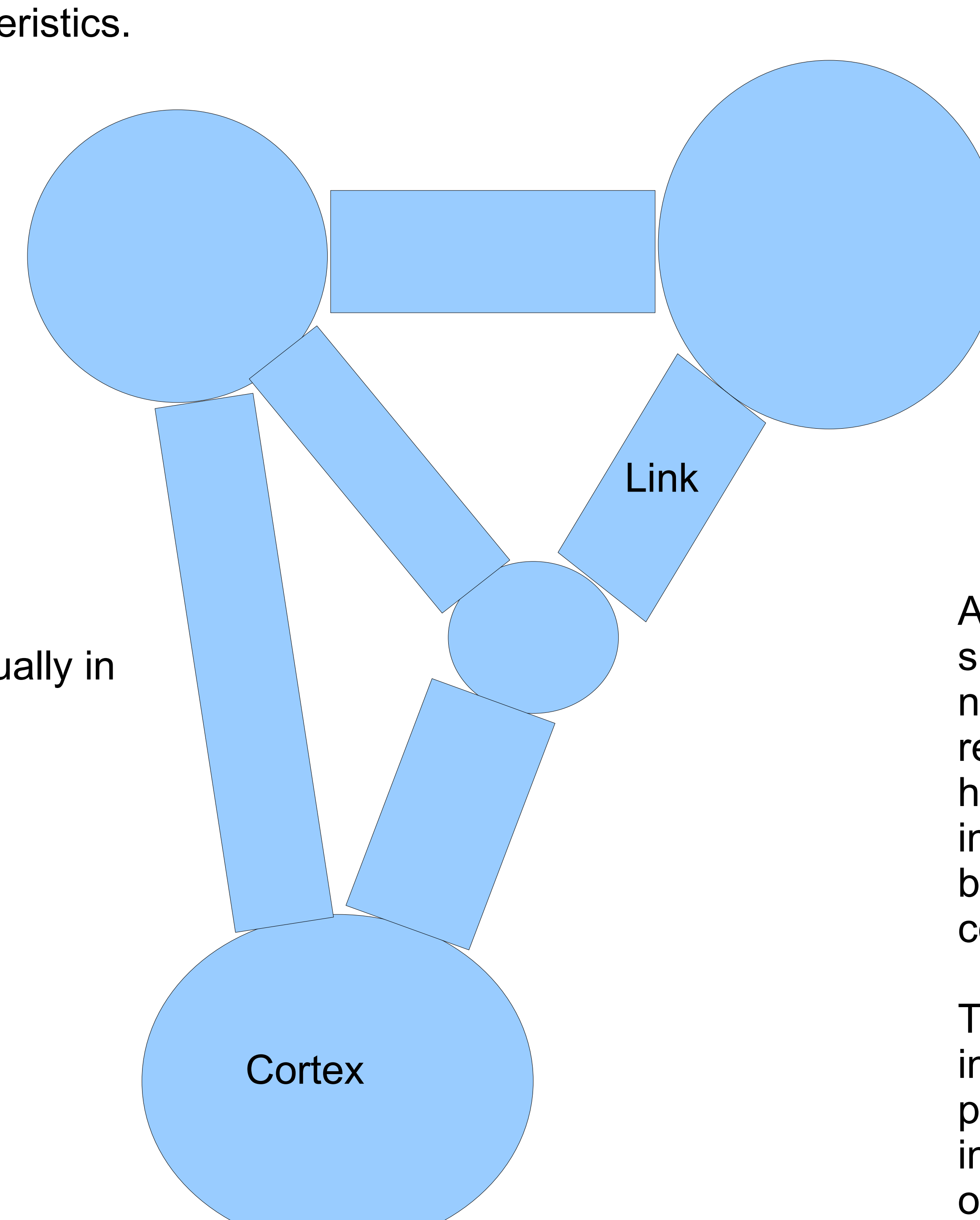
Connections in the network are reinforced when the nodes they connect activate synchronously, a process called Hebbian Learning

This project is an attempt to improve on existing neural network (NN) approaches to problem solving. Although the brain, which is a poster child for unsupervised NN, is adept at dialog processing, standard computer science neural networks, supervised NN, have no way to approach this problem. I tried to mimic the functionality of the brain in a number of ways that go beyond standard methods.

In general, NN are limited in the number of possible nodes and connections by processing power. However, while the number of nodes and connections that encode meaningful information are only directly proportional to the amount of information to be encoded, it is optimal to have an unlimited number of connections and nodes available for future incorporation into the meaningful node structure. To that end, my program keeps track of the statistically probably information of nonexistent nodes that may be meaningfully connected to in the future.

While standard NN only store several variables related to each node and connection, it is helpful to store a variety of variables, including one which is most comparable to the metaplasticity of neurons in the brain. This is very important, because allows for variations in flexibility across the nodes. That is to say, it allows some connections to remember things long term, and other connections to remember things short term. This lets the network be flexible in response to short term changes while its behavior still reflects changes made a long time ago, since different connections handle those.

Similar to the way neural networks in the brain, nodes in an artificial unsupervised neural network can be organized into different areas, connected by links, which basically contain supervised neural networks. This provides a convenient discrimination to organize nodes by characteristics.



(Actually in 3D)

A Link is like a supervised neural network in many respects. It handles interactions between the cortices.

The Cortices are involved with processing many inputs and outputs to the links.