

From neurons to Brains

Building a better model

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Purpose

- To create a model biologically inspired neurological model.
- Approach a tired old problem from a different point of view.

A biological neuron

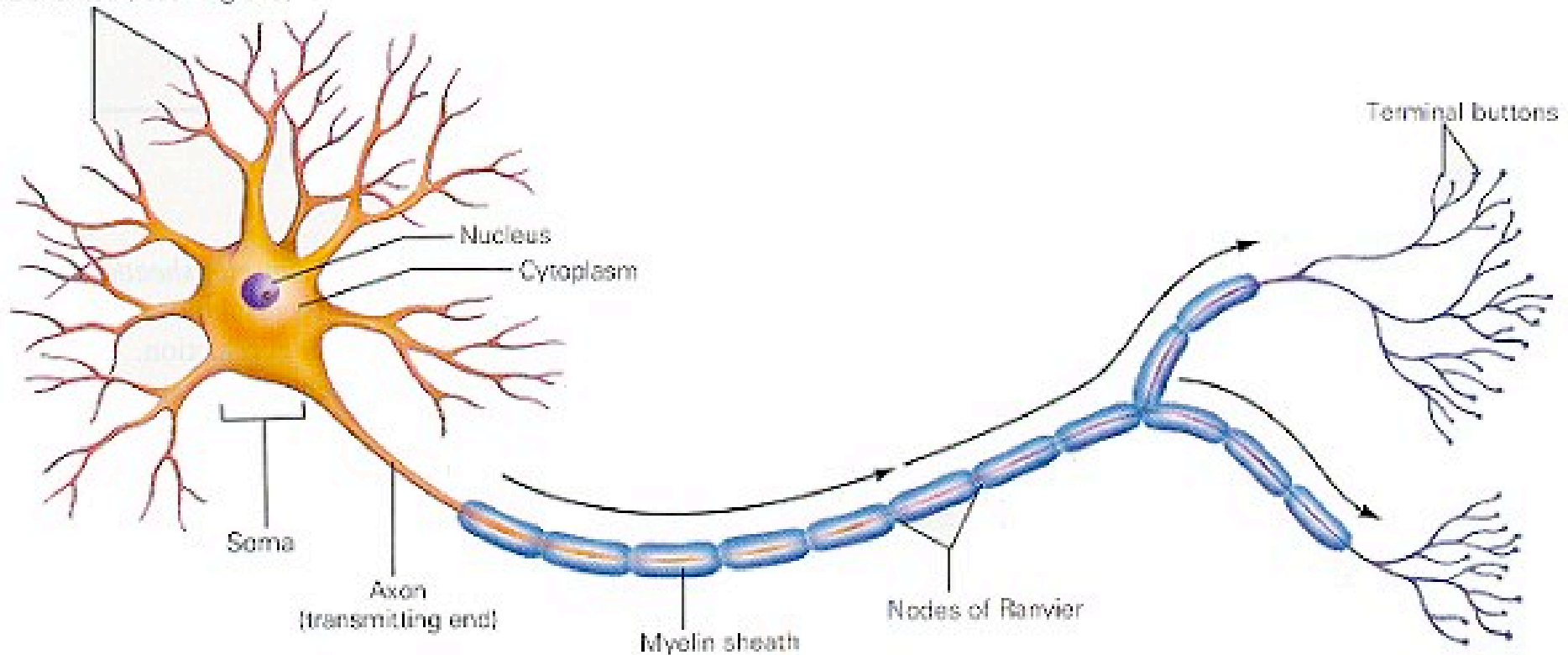
- Dendrite
- Soma
- Axon
- (Picture Courtesy of Wikipedia and Mark Echidna)

A picture

THE MAJOR STRUCTURES OF THE NEURON

The neuron receives nerve impulses through its dendrites. It then sends the nerve impulses through its axon to the terminal buttons where neurotransmitters are released to stimulate other neurons.

Dendrites (receiving end)



A digital neuron

- A data structure containing the following information:
 - A flag stating if its active or not
 - A strength value $[0,1]$
 - A dampening value $[0,1]$
 - A list of strength values of neurons touching it
 - A list of dampening values of all neurons connected to it
 - A list of neurons it touches

Rules of the game

- The active flag triggers the recalculation of the neuron's strength and dampening value.
- Strength is calculated by summing its current value with the strength values of the neurons that touch it. Then divide that by the number of neurons involved to normalize.

More rules

- Dampening is the same calculation using all the known dampening values.
- If the dampening value exceeds the strength value then the strength value is set to zero.

Now what?

- Build a machine, link neurons, and see what happens.

Problems

- Neurotransmitters (doh!)
 - How do they effect the strength value?
- Freak effects
 - Concurrent, non-causal firing.
- Internal dynamics
 - How does this model account for signal leak along the axon?
 - Refractory period

Bibliography

- Gazzinga, M. S., R. B. Ivry, et al. (2002). Cognitive Neuroscience, Norton.
- Bugmann, G. (1997). "Biologically plausible neural computation." Biosystems(40): 11-19.