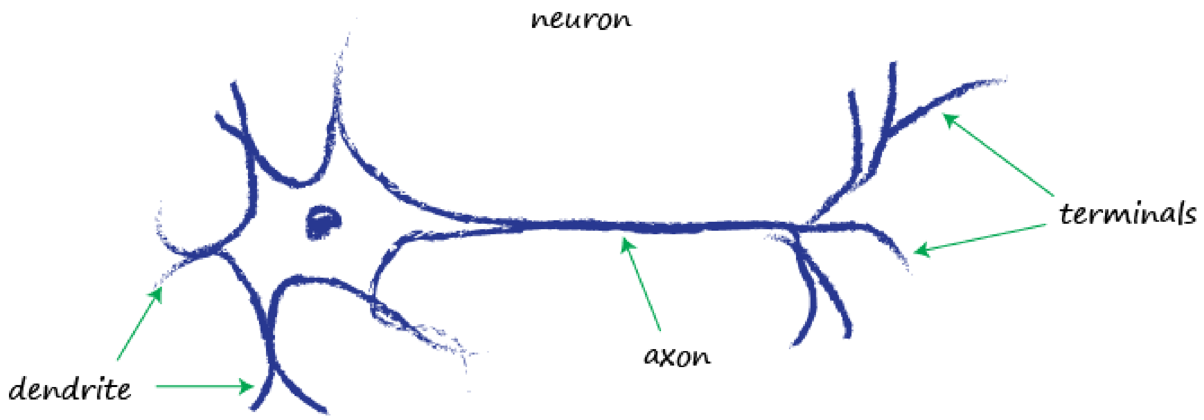
Neurons, Nature’s Computing Machines

A brief introduction to a basic unit of the biological brain, i.e., Neuron and its working.

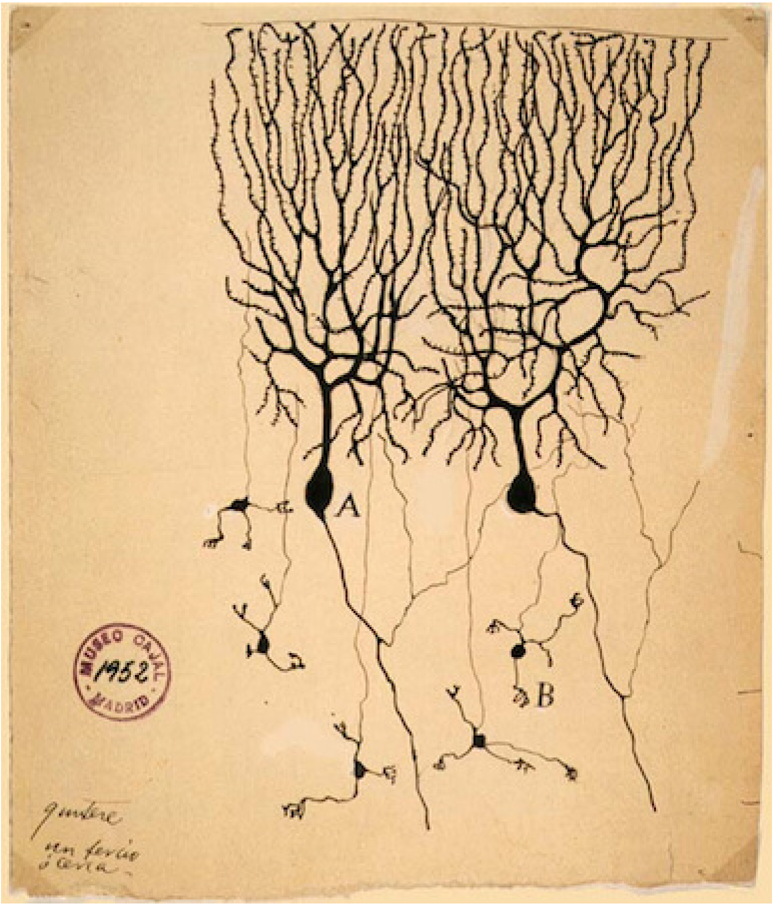
We said earlier that animal brains puzzled scientists because even small ones like a pigeon brain were vastly more capable than digital computers with huge numbers of electronic computing elements, huge storage space, and all running at frequencies much faster than fleshy squishy natural brains.

Attention turned to the architectural differences. Traditional computers processed data very much sequentially and in pretty exact concrete terms. There is no fuzziness or ambiguity about their cold hard calculations. Animal brains, on the other hand, although apparently running at much slower rhythms, seemed to process signals in parallel, and fuzziness was a feature of their computation. Let’s look at the basic unit of a biological brain — the *neuron*:



Neurons, although there are various forms of them, all transmit an electrical signal from one end to the other, from the dendrites along the axons to the terminals. These signals are then passed from one neuron to another. This is how your body senses light, sound, touch pressure, heat and so on. Signals from specialized sensory neurons are transmitted along with your nervous system to your brain, which itself is mostly made of neurons too.

The following is a sketch of neurons in a pigeon's brain, made by a Spanish neuroscientist in 1899. You can see the key parts — the dendrites and the terminals.



How many neurons do we need to perform interesting, more complex, tasks?

Well, the very capable human brain has about 100 billion neurons! A fruit fly has about 100,000 neurons and is capable of flying, feeding, evading danger, finding food, and many more fairly complex tasks. This number, 100,000 neurons, is well within the realm of modern computers to try to replicate. A nematode worm has just 302 neurons, which is positively minuscule compared to today's digital computer resources! But that worm is able to do some fairly useful tasks that traditional computer programs of much larger size would struggle to do.

So what's the secret? Why are biological brains so capable given that they are much slower and consist of relatively few computing elements when compared to modern computers? The complete functioning of brains, consciousness, for example, is still a mystery, but enough is known about neurons to suggest different ways of doing computation, that is, different ways to solve problems.