Inspiration from the Brain

Scientists often look to nature for inspiration when performing incredible feats. Notably, the birds inspired the airplane. In that vein, there is no better type to study as an antitype of intelligence as the human brain.

We can view the brain as a society of intelligent agents that are networked together and communicate by passing information via electrical signals from one agent to another. These agents are known as neurons. Our principal interest here is to have a glimpse of what neurons are, what their components are, and how they pass information around to create intelligence.

A neuron is an autonomous agent in the brain and is a central part of the nervous system. Neurons are responsible for receiving and transmitting information to other cells within the body based on external or internal stimuli. Neurons react by firing electrical impulses generated at the stimuli source to the brain and other cells for the appropriate response. The intricate and coordinated workings of neurons are central to human intelligence.

The following are the three most essential components of neurons that are of primary interest to us:

- The axon
- The dendrite
- The synapse

The axon is a long tail connected to the nucleus of the neuron as seen in Figure 27-1. The axon is responsible for transmitting electrical signals from the nucleus to other neuron cells through the axon terminals. The dendrite, on the other hand, receives information as electrical impulses from other neuron cells through the synapses to the nucleus of a neuron cell.

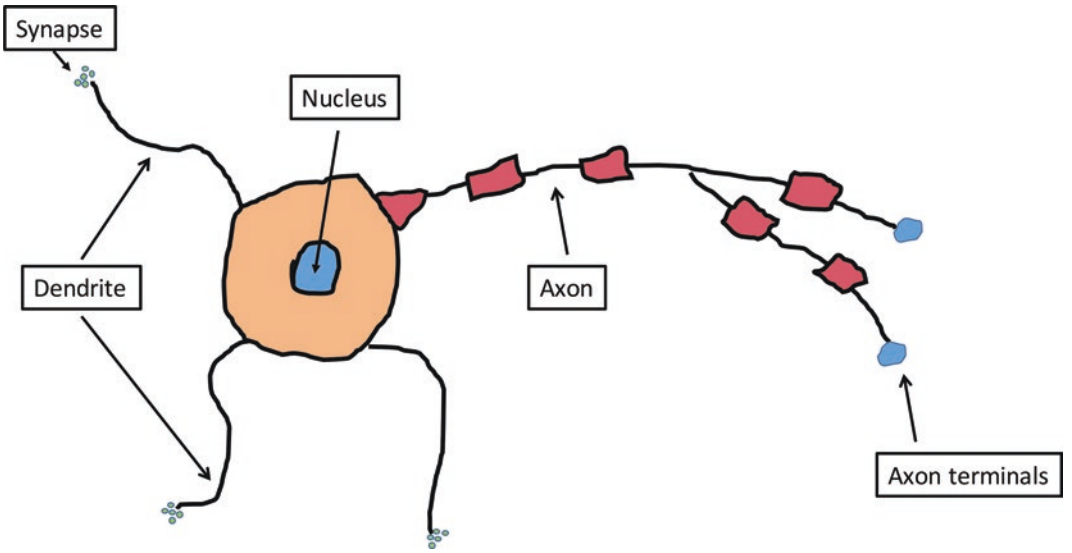

Figure 27-1. *A neuron*

By mimicking these three biological components of a neuron, scientists developed the core design and structure of an artificial neural network (ANN) that allows us to build machines that can learn. We will discuss the ANN in more detail in the next chapter. There is much hope that if we can mimic the capabilities of the brain from a science and engineering perspective, we can build machines that can learn hierarchical features from complex domain use cases.

This chapter introduces the field of deep learning as an engineering impersonation of how the brain learns to build artificial neural networks. In the next chapter, we'll go deeper to discuss the neural network algorithm.

CHAPTER 28

Neural Network Foundations

Building on the inspiration of the biological neuron, the artificial neural network (ANN) is a society of connectionist agents that learn and transfer information from one artificial neuron to the other. As data transfers between neurons, a hierarchy of representations or a hierarchy of features is learned, hence the name deep representation learning or deep learning.

The Architecture

An artificial neural network is composed of

- An input layer
- Hidden layer(s)
- An output layer

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