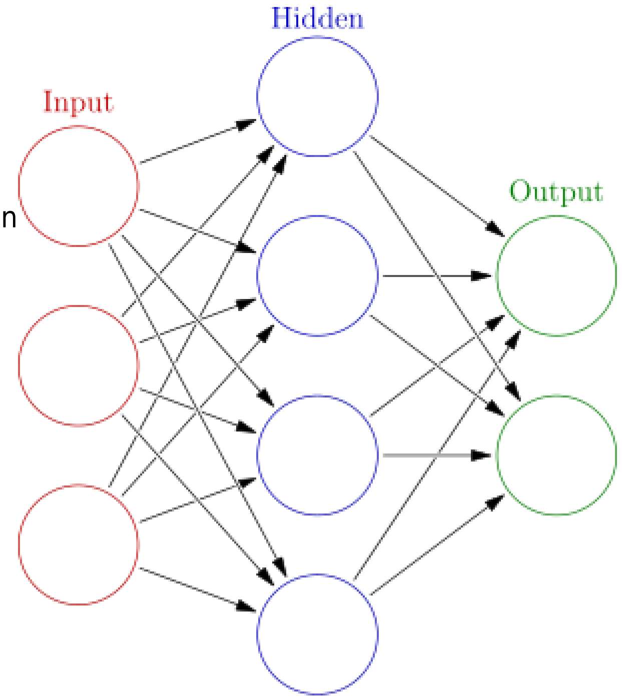
Artificial neural network



Neural networks and other artificial intelligence programs require an initial set of data, called a training dataset, to act as a baseline for further application and utilization. This dataset is the foundation for the program's growing library of information. The training dataset must be accurately labeled before the model can process and learn from it.

Composition

Artificial neural networks are typically composed of input layers, hidden layers, and output layers. Other components may include convolutional layers and encoding or decoding layers.

see Neural network simulator

Neural networks (also referred to as connectionist systems) are a computational approach, which is based on a large collection of neural units (AKA artificial neurons), loosely modeling the way a biological brain solves problems with large clusters of biological neurons connected by axons. Each neural unit is connected with many others, and links can be enforcing or inhibitory in their effect on the activation state of connected neural units. Each individual neural unit may have a summation function which combines the values of all its inputs together. There may be a threshold function or limiting function on each connection and on the unit itself: such that the signal must surpass the limit before propagating to other neurons. These systems are self-learning and trained, rather than explicitly programmed, and excel in areas where the solution or feature detection is difficult to express in a traditional computer program.

Understanding the detailed dynamics of neuronal networks will require the simultaneous measurement of spike trains from hundreds of neurons (or more). Currently, approaches to extracting spike times and labels from raw data are time consuming, lack standardization, and involve manual intervention, making it difficult to maintain data provenance and assess the quality of scientific results. Here, we describe an automated clustering approach and associated software package that addresses these problems and provides novel cluster quality metrics. We show that our approach has accuracy comparable to or exceeding that achieved using manual or semi-manual techniques with desktop central processing unit (CPU) runtimes faster than acquisition time for up to hundreds of electrodes. Moreover, a single choice of parameters in the algorithm is effective for a variety of electrode geometries and across multiple brain regions. This algorithm has the potential to enable reproducible and automated spike sorting of larger scale recordings than is currently possible [1)].

Analysis

see Artificial neural network analysis.

Artificial neural networks are generally presented as systems of interconnected “neurons” which exchange messages between each other. The connections have numeric weights that can be tuned based on experience, making neural nets adaptive to inputs and capable of learning.

For example, a neural network for handwriting recognition is defined by a set of input neurons which may be activated by the pixels of an input image. After being weighted and transformed by a function (determined by the network's designer), the activations of these neurons are then passed on to other neurons. This process is repeated until finally, the output neuron that determines which character was read is activated.

Like other machine learning methods – systems that learn from data – neural networks have been used to solve a wide variety of tasks, like computer vision and speech recognition, that are hard to solve using ordinary rule-based programming.

see Artificial neural network for lumbar discectomy outcome prediction.

see Artificial neural network for traumatic brain injury mortality prediction.

1)
Chung JE, Magland JF, Barnett AH, Tolosa VM, Tooker AC, Lee KY, Shah KG, Felix SH, Frank LM, Greengard LF. A Fully Automated Approach to Spike Sorting. Neuron. 2017 Sep 13;95(6):1381-1394.e6. doi: 10.1016/j.neuron.2017.08.030. PubMed PMID: 28910621; PubMed Central PMCID: PMC5743236.