Artificial Neural Network

For Artificial learning and Predictive Capabilities in Computes.

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Choose Ohio First

Abstract

Artificial neural network is a network of computing system modeled after a biological brain. Like a biological brain it has neurons called nodes and an action potential called the activation function. The purpose of an artificial neural network is to model learning for a machine by the propagation of a machine learning algorithm on the network. There are many different types of neural networks but only one would be focused on in the this poster. which is the convolutional network it is based on a frame work of machine learning called deep learning. why this framework is called deep learning would be discussed in the poster. We will also discuss the components and methodology of building a real convolutional neural network.

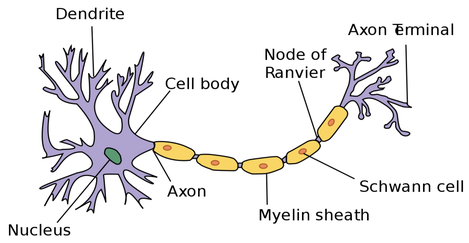
Brief History

Artificial Neural network from its very inception is inspired by the its biological counterpart. In 1949 a neurophysiologist warren McColloch and mathematician Walter pits attempted to describe how neurons work in the brain . To do this they tried to model the brain using an electrical circuit. In 1959 a neural network model called MADALIE (multiple adaptive linear elements) was developed. This model was used to predict the next bits on a phone line. It became an adaptive filter for phones as to prevent echoes. It was the first artificial neural net work used for a real world problem and is still being used today.

Artificial Neural Network

Artificial neural network is a computer network modeled after the brain. They are meant to be a tool in artificial intelligence to give computers predictive and learning capabilities. They are pattern oriented and consist of basic components called nodes or artificial neurons. This nodes are arranged in layers that work on portions of a given problem in parallel and relay information about that problem to another layer that further expatiate on that problem and either send to an output or relay yet more sophisticated information about the problem to another layer that further work on portions of the problem with more sophisticated knowledge .

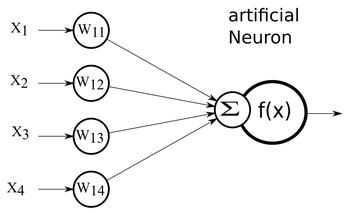
Biological Neuron



Neuron communication

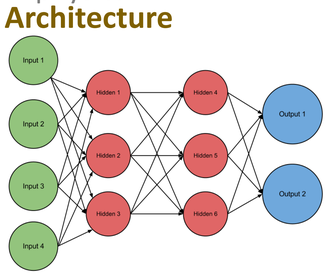
Neurons receive excitatory and inhibitory message, the message is then summed up and fires by a process of action potential (consists of a wave of electrically charged ions moving into and out of the axon). Note action potential either fires all at once or not at all. Once firing occurs neuro transmitter are sent through the terminal via synaptic vesicles that pass through the synaptic gap to another neuron dendrite (message).

Artificial Neuron



- Like its biological counterpart Artificial neuron(nodes) take in inputs from either a sensor or other nodes.
- They process this inputs by multiplying by some predetermined standard called weights.
- And like biological neuron they sum the multiplications in activation function(biology action potential) and relay the message to another node.
- Nodes however are abstract compared to their biological counter parts which are physical.

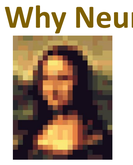
Architecture



Advantages

1. Adaptivity
2. Evidential response
3. Fault tolerance
4. Uniformity

Why Neural Networks?



$$\int \sin^2\left(\frac{1}{2}x^2\right) dx$$

- Brain behavior replication- the brain Is good at recognizing patterns.
- Using to pattern to learn and predict.
- Thus capable of solving certain problem traditional programing cant solve easily.
- Thus we aim to mimic the brain in an electronic computational environment so we can solve such problem easily.

Examples of such problem includes

- image recognition.
- Auditory recognition.
- Image and auditory replication.
- Adaptive learning

Mathematics of Neural Network

$Y = x * w \quad W = y/x$

$E = (x * w) - y$

The guessing game

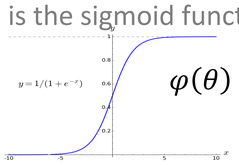
Learning -> is when we reduce E to almost zero by guessing the weight (w)

Supervised learning->knowing the state of the network when there is a given input and output and tuning W so E comes out to almost zero.

Transfer Function

$$\theta = \sum x_{ij} w_{ij}$$

Activation Function->is nonlinear, differentiable, symmetrical function that allows the node to transfer to the next layer node. A common one is the sigmoid function.

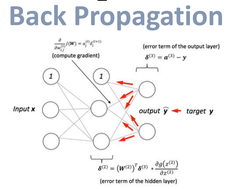


$$\varphi(\theta) = \frac{1}{1 + \exp(-\theta)}$$

Error Function->This would be an average of all the error from the processed data so we can retune the weight to get better results.

$$\text{error} = \frac{1}{2} \sum_{i=1}^{n} E_i^2$$

Back Propagation



The Convolutional Neural Network

Implementation

Neural network abstract by nature and can be implemented theoretically on any computational platform. However the common way to implement it in real life is by the use of GPU cores because they are parallel nature. Such cores are numerus in size making them a good platform for node implementation. In terms of software there are frame works which programing language adopt to manipulate these cores. Such frame works are

- Tensor flow
- keras

Everything we have covered till now describes the inner workings of the convolutional neural network. However in a very general sense in more specific sense the net work is said to be convolutional because it performs mathematical operation on the aggregated data units of the problem to determine little bits information about the Problem in layers repeatedly.

Conclusion

Artificial neural network is not the end all beat all solution to computation. It is simply that tool that took us to a more natural way of learning in machine learning. The idea is to give machines the ability to articulate and solve problems humans are good at solving but it could be a terrible solution for problems we already know how to solve with programing at least in terms of speed. Ultimately it is good at the things the human brain is good at bad at the things the human brain is bad at. Ultimately I see a future where we have systems like this automated to supervise each other. Hence feeding of each other skills to become even more articulate in thing we never taught it.

Citation

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