Neural Network An Overview In Deep Learning

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Abstract

Deep learning is a set of learning methods attempting to model data with complex architectures combining different non-linear transformations. The elementary bricks of deep learning are the neural networks that are combined to form the deep neural networks. Deep learning allows computational models that are composed of multiple processing layers to learn representations of data with multiple levels of abstraction. These methods have dramatically improved the state-of-the-art in speech recognition, visual object recognition, object detection and many other domains.

Keywords: Deep learning, Unsupervised Pretraining, Recurrent Neural Network, Recursive Neural Network, Convolution Neural Network

I. Introduction

Deep Learning is an artificial intelligence function that imitates the workings of the human brain in processing data and creating patterns for use in decision making. Deep learning is a subset of machine learning in Artificial Intelligence that has networks capable of learning unsupervised from data that is unstructured or unlabelled. Deep Learning has evolved hand-in-hand with the digital era, which has brought about an explosion of data in all forms and from every region of the world.

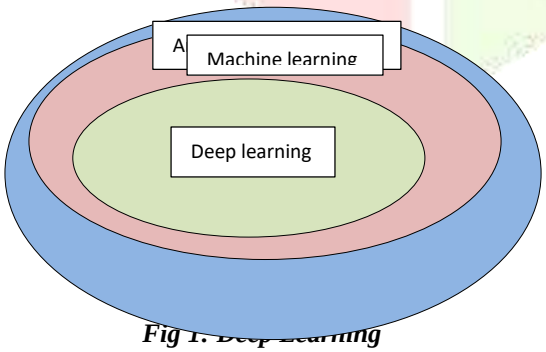

Fig 1: Deep Learning

Deep learning, a subset of machine learning, utilizes a hierarchical level of artificial neural networks to carry out the process of machine learning. The artificial neural networks are built like the human brain, with neuron nodes connected together like a web. Algorithms used in machine learning, used to model high-level abstractions in data through the use of model architectures, which are composed of multiple nonlinear transformations. It is part of a broad family of methods used for machine learning that are based on learning representations of data. Deep learning removes the manual identification of features in data and, instead, relies on whatever training process it has in order to discover the useful patterns in the input examples. This makes training the neural network easier and faster, and it can yield a better result that advances the field of artificial intelligence.

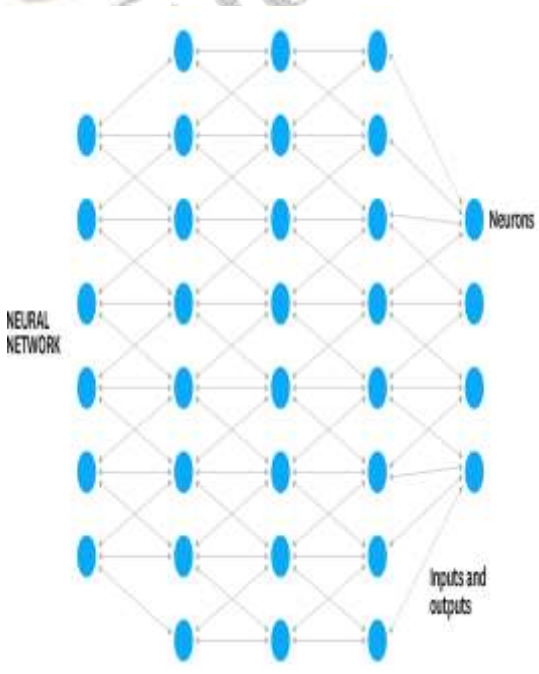

Fig 2: Neural Network

The first layer of the neural network processes a raw data input like the amount of the transaction and passes it on to the next layer as output. The second layer processes the previous layer's information by including additional information like the user's IP address and passes on its result. The next layer takes the second layer's information and includes raw data like geographic location and makes the machine's pattern even better. This continues across all levels of the neuron network.

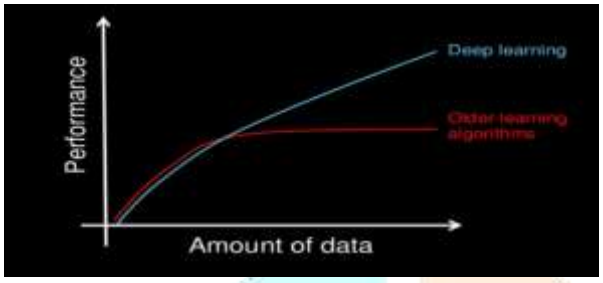

Fig 3: Performance Of Deep Learning

II. Practical Applications of Deep Learning

Machine learning system created a model with parameters built around the amount of dollars a user sends or receives the deep learning method can start building on the results offered by machine learning. Each layer of its neural network builds on its previous layer with added data like retailer, sender, user, social media event, credit score, IP address and a host of other features that may take years to connect together if processed by a human being. Deep learning algorithms are trained to not just create patterns from all transactions, but to also know when a pattern is signalling the need for a fraudulent investigation. The final layer relays a signal to an analyst who may freeze the user's account until all pending investigations are finalized.

III. Unsupervised Pretraining

Neural networks have thousands, often millions of parameters. They take hundreds of features and predict thousands of classes. The features can often not be seen independently, but have to be taken as a whole into consideration. Most parameters are not independent either. And still, we use only on the order of several ten-thousand to a million data points to optimize the millions of parameters in a network. We know that more labelled data leads to better results, but labelling is costly. Obtaining more data, however, is comparatively cheap. Hence we want to use the unlabelled data to learn good features. The below are some of the unsupervised pretrained methods.

1. Auto-Encoders

An auto encoder is an artificial neural network used for unsupervised learning of efficient codings.The aim of an auto encoder is to learn a representation (encoding) for a set of data, typically for the purpose of dimensionality reduction. This means you have to choose your activation function carefully and probably normalize the range of values of the input. For example, if your inputs have negative values you cannot use the logistic function or ReLU. you have to make sure the shape of the output is the same as the input.

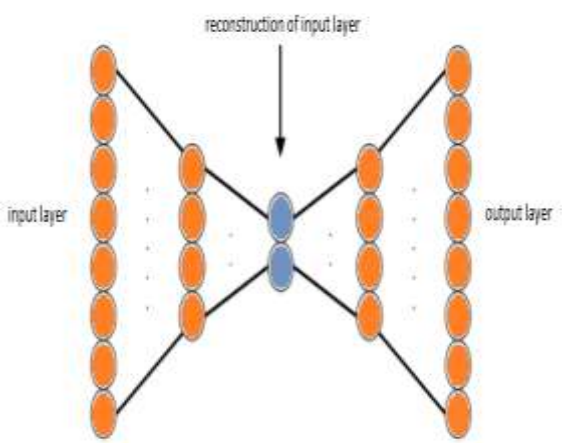

Fig 4: Auto Encoder

2. Crop position prediction

If you have a CNN and images as input, crop it into 9 pieces which are loosely placed in a grid over the image (with some variable padding). Give the network the middle crop and randomly one of the 8 others. The network has to predict which crop it got. Hence the network has 8 output units.

3. Weakly Supervision

The more detailed / high quality labels are, the more expensive. For example, it is often simpler to classify one complete image than to assign a class label to each pixel of the image. But you can build models for semantic segmentation without having a single image which was semantically labelled.

IV. Recurrent Neural Network

Recurrent Neural Networks are one of the most common Neural Networks used in Natural Language Processing. We can predict the model or guess the sentences for us and correct the error during prediction or we can train the model on particular genre and it can produce text similar. To predict the next word in the sentence we need to remember what word appeared in the previous time step. These neural networks are called Recurrent. As these neural networks consider the previous word during predicting, it acts like a memory storage unit.

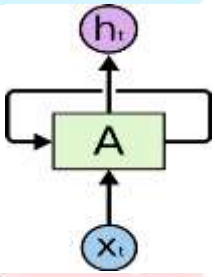

Fig 5: Recurrent Neural Network

RNNs can handle context from the beginning of the sentence which will allow more accurate predictions of a word at the end of a sentence. RNNs faded out from practice for a while until some great results were achieved with using a Long Short Term Memory (LSTM) unit inside the Neural Network. These little memory units allow for RNNs to be much more accurate, and have been the recent cause of the popularity around this model. These memory units allow for the ability across inputs for context.

V. Recursive Neural Network

A recursive neural network (RNN) is a kind of deep neural network created by applying the same set of weights recursively over a structured input, to produce a structured prediction over variable-size input structures, or a scalar prediction. RNNs have been successful, for instance, in learning sequence and tree structures in natural language processing, mainly phrase and sentence continuous representations based on word embedding.

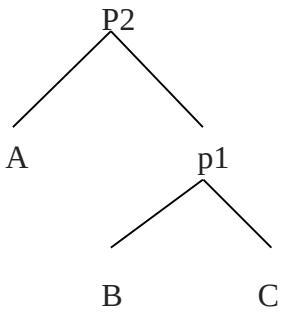

Fig 6: Recursive Neural Network

Each parent in tree is computed with two children's .The recursively in the tree comes from the application of the same parameter when calculating each parent node. The weight of the matrix is calculated by W € Rn *2n where n is the length of your word.

VI. Long-Short Term Memory

Long Short-Term Memory (LSTM) networks are an extension for recurrent neural networks, where basically extends its memory .It is well suited to learn from important experiences that have very long time lags in between.The units of an LSTM are used as building units for the layers of a RNN, which is then often called an LSTM network.

LSTM's enable RNN's to remember their inputs over a long period of time. This is because LSTM's contain their information in a memory where it like the memory of a computer because the LSTM are able to read, write and delete information.

This memory can be seen as a gated cell, where gated means that the cell decides whether or not to store or delete information based on the importance it assigns to the information. The assigning of importance happens through weights, which are also learned by the algorithm. This simply means that it learns over time which information is important and which not.

In an LSTM you have three gates: input, forget and output gate. These gates determine whether or not to let new input in (input gate), delete the information because it isn't important (forget gate) or to let it impact the output at the current time step (output gate).

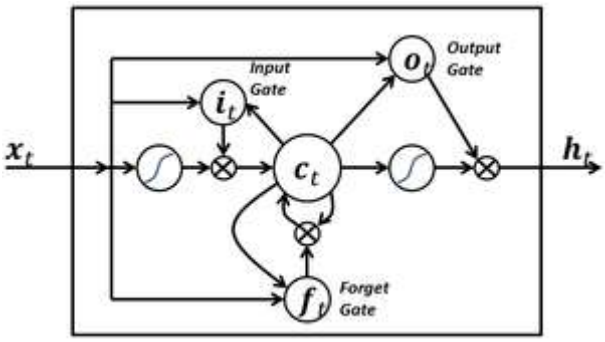

Fig 7: Long-Short Term Memory

VII. Convolutional Neural Network

Convolutional neural networks are used to classify images, cluster them by similarity and perform object recognition within scenes. They can identify faces, individuals, tumours, street signs platypuses and many other aspects of visual data. Convolutional networks perform optical character recognition (OCR) to digitize text and make natural-language processing possible on analog and hand-written documents, where the images are symbols to be transcribed. It is applied to sound when it is represented visually as a spectrogram.

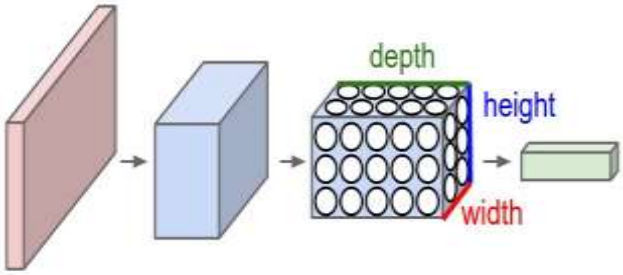

Fig 8: Convolution Neural Network

Convolutional networks perceive images as volumes; i.e. three-dimensional objects, rather than flat canvases that is to be measured by width and height. The digital color images have a red-blue-green (RGB) encoding, mixing those colors to produce the color spectrum humans perceive.convolutional network receives a normal color image as a rectangular box whose width and height are measured by the number of pixels along with the dimensions, and whose depth is three layers deep, one for each letter in RGB. Those depth layers are referred to as channels.As images move through a convolutional network, we will describe them in terms of input and output volumes, expressing them mathematically as matrices of multiple dimensions.

VIII. Conclusion

Neural network gives impressive performance, that performance, the weights and biases in the network were discovered automatically. The computing world has a lot to gain from neural networks. They are also very well suited for real time systems because of their fast response and computational times which are due to their parallel architecture. Neural networks also contribute to other areas of research such as neurology and psychology. They are regularly used to model parts of living organisms and to investigate the internal mechanisms of the brain.