ISSN:0975-9646

Deep Learning: The Holy Grail of Artificial Intelligence?

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Artificial Intelligence has been ruling the world from the mid-19th century, with one simple goal; to create a machine capable of understanding humans. Though this work seemed a pretty far stretch a decade ago, presently, the probability of achieving our goal have improved with advances in the field of AI such as machine learning, which started to spread rapidly in the past years. Currently, the field of AI which is being given a lot of importance is Deep Learning. Scientists and researchers assert that with suitable research and development of optimal algorithms, the day is not far when we can build machines that are capable of programming other machines, and they are sure that Deep Learning has a major part to play in this scenario.

One of the major problems associated with Deep Learning is there is no suitable definition to keep the concept "simple". But it can be considered as a concept which is a subset of Machine Learning and uses Artificial Neural Networks, the same structures that are used in the working of a human being's brain. For example, the way we perceive certain things such as the color of a rose, or the chirping of a bird, with the advancement of Neural Networks in the field of Artificial Intelligence, we are able to map the way our neurons work to a computer. Though we are still in a rudimentary stage for implementing an error free machine, with the augmentation of various techniques in the field daily, we are slowly starting to reach our goal. Dr. Andrew Ng, the co-founder and CEO of Coursera and a Machine Learning researcher shared his thoughts, "…. is the scale at which we can do these things. Increased computing power has allowed us to map and process much larger neural networks than ever before. We also have a lot more data that we can use to train these networks." He explained the entire process in an abstract statement, "You train a computer to recognize a cat is by showing it thousands of cat pictures." His explanation sure shows that Deep Learning is the future of Artificial Intelligence and Neural Technologies.

The main area of research in AI is being conducted in the field of Natural Language Processing. A rather tough subject, but the application has a vast scope. The subject mainly deals with speech recognition, the one which is widely used in many smart phones. For example, Apple's Siri, and Microsoft's Cortana belong to this category. As per the TIMIT Dataset used for learning speech recognition, when the research was started using Randomly Initialized RNN (Recurrent Neural Network), the error-rate was as high as 26.1%. After further works, through using a Bidirectional LSTM RNN (Long Short-Term Memory), the error rate decreased steadily to 17.9%. Then, between the years 2009-2011, Deep Neural Networks were used to work on this application. Today, the same TIMID Dataset is performing exceptionally well with an error rate of less than 1.5%. Correlating to this, on an article ("Deep Neural"), the researchers assert the same, "Deep neural networks (DNNs) that have many hidden layers and are trained using new methods have been shown to outperform GMMs [Gaussian Mixture Models] on a variety of speech recognition benchmarks, sometimes by a large margin."

When we take a language test, we are assessed in all formats that cover the entire responsive senses of our body – Listening, Reading, Writing and Speaking. This can be said as an analogy to the development of a human-like machine. A machine should be able to recognize and understand the things it can visualize, should identify the tone of the opposite person, must perceive the surroundings and must "behave" according to the situation. Having discussed the ears of the machine, now we are going to look at the eyes. A competition named ImageNet has been setting up of the stage for the future of computer vision. The competition is to develop a machine that can recognize handwritten alphabets across a huge number of languages. ("A new, deep") This article published on Microsoft Research Asia website says "…such networks are called "deep convolutional neural networks" (CNNs), which are inspired by biological processes of the human brain." Dr. Jian Sun states, "The new technique is 20 to 100 times faster than the previous leading solutions for [visual] detection."

Not only in Machine Learning, Deep Learning has also laid its hands in bioinformatics. Gene Ontology, the major initiative to unify the representation of gene and gene product attributes across all species. In their article, Michael K. K. Leung et al. on Alternative Splicing(AS) , they report, "…the deep architecture surpasses the performance of the previous Bayesian method for predicting AS patterns." Using deep neural networks, they stated that, "[We] developed a model inferred from mouse RNA-Sequenced data that can predict splicing patterns in individual tissues and differences in splicing patterns across tissues. Our architecture uses

hidden variables that jointly represent features in genomic sequences and tissue types when making predictions." This work shows that Deep Learning is travelling across all disciples in the field of science.

Though the applications are thoroughly considered, there still exists a lack of complete development in the field. Most of the learning in deep architectures is just some form of gradient descent. While gradient descent has been understood for a while now, some algorithms such as contrastive divergence, the theory surrounding it and other algorithms, is less clear. Questions whether the algorithm converges or not, how fast it does, the computation speed, etc. are yet to be calculated. Some currently popular and successful deep learning architectures display certain problematical behaviours. "Confidently classifying random data as belonging to a familiar category of non-random images; and misclassifying minuscule perturbations of correctly classified images." (Szegedy).

To sum up, the subject is still a bit problematic as it is in its primary stages. As the time progress, after a decade or so, we will be able to perceive our dream of building a fully functional humanoid. Deep Learning, if given sufficient time to develop, can also be useful for creating some variety applications which are unknown at this time.

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