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Deep Learning Solicitation in Machine Vision System

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ABSTRACT

Artificial intelligence is the science that entirely focuses on creating intelligent machines, softwares that can think, mimic and responds like humans. Deep Learning is subspace of Machine Learning. [2] In Deep Learning, the systems are equipped for learning and separating the information that is unstructured or unlabeled. Deep Leaning is a component of Artificial Intelligence that mimics the activity of human mind in preparing information and making designs for use in decision making. It is otherwise called known as deep neural learning or deep neural system. Deep Learning offers various applications in real world areas. This paper describes about the deep learning evolution and the methodology involved in it. The role of activation function in deep learning is described in this paper along with the future aspects of deep learning application in real world.

Keywords : Artificial Intelligence, Deep Learning, Machine Learning, Activation function, Applications of Deep Learning in various fields, Deep Learning Benefits.

I. INTRODUCTION

In the field of Computer Science, there are two different ways by which we can accomplish Artificial Intelligence. First way is Machine Learning. [1] Second approach to accomplish AI is Deep Learning. Deep learning is a class of machine learning algorithms that use numerous layers to continuously extract higher level of features from the given data. For instance, in image processing, lower layers may recognize edges, while higher layers may distinguish the concepts pertinent to a human, for example, digits or letters or faces. [4]

Deep learning is an artificial intelligence function that emulates the activities of the human brain in handling information and making designs for use in decision making. Deep learning is a subset of machine learning in artificial intelligence (AI) that has systems equipped for learning unaided from information that is unstructured or unlabeled. Otherwise it is called deep neural learning or deep neural system. Deep Learning requires enormous information, provides high accuracy, takes more time to prepare, requires GPU to train appropriately and can be tuned in different various manners.

Deep Learning is further developed when compared with Machine Learning as Feature extraction and Arrangement is done in one stage only.[5] Deep Learning is a technique to perform machine learning

propelled by human brain's system of neurons. The AI research into network analysis is solving the absolute most innovation issues related to software and hardware infrastructure, hypothesis and calculations [20]. Deep learning learns from vast amounts of unstructured data that could normally take humans decades to understand and process. It uses many-layered neural networks to build algorithms that find the best way to perform tasks on their own, based on vast sets of data. In deep learning, each level figures out how to change its information into a somewhat increasingly unique and composite representation. [19]

Following headings will explain about the History of Deep Learning, its related work, Benefits and appropriate flowchart. Neural network activation functions are a crucial component of deep learning. Activation functions determine the output of a deep learning model, its accuracy and also the computational efficiency of training a model—which can make or break a large scale neural network. [3] Activation functions also have a major effect on the neural network's ability to converge and the convergence speed, or in some cases, activation functions might prevent neural networks from converging in the first place.

II. BENEFITS OF DEEP LEARNING OVER OTHER TECHNOLOGIES

Large numbers of technology giants are relentlessly receiving Deep Learning. Deep Learning offers various advanced features that are comparatively better than other traditional techniques. Some Major advantages of Deep Learning over other techniques are mentioned below:

A. Maximum usage of Unstructured Data

Research from Gartner uncovered that a colossal level of an association's information is unstructured because the most of it exists in various sorts of arrangements like pictures, texts and so on.[7] For most of AI calculations, it's hard to examine unstructured data, which implies it's remaining unutilized and this is actually where deep learning gets helpful. You can use different data formats to train deep learning algorithm and still get bits of knowledge which are important to the purpose behind the training. For instance, you can use deep learning algorithms to uncover any existing relations between industry analysis, social media chatter, and more to predict upcoming stock prices of a given organization.

B. Elimination of the Need for Feature Engineering

One of the greatest benefits of utilizing deep learning approach is its capacity to execute feature engineering by itself. [9] In this approach, calculation examines the information to recognize feature which connect and promote faster learning without being told to do so explicitly. This ability allows data scientists to save a significant amount of work.

C. Capacity to Deliver Top Notch Results.

A Deep Learning model is capable to perform a huge number of standard, repetitive tasks inside a moderately shorter time frame contrasted with what it would take for an individual. [8] On adding more to it, the nature of the work never degrades, except if the training data contains raw data which doesn't represent to the issue the individual is trying to understand.

D. Elimination of Unnecessary Costs

Resolution of defects via traditional techniques is highly expensive at industry level. With the assistance of deep learning, subjective defects which are difficult to prepare like minor product labeling mistakes and so forth can be identified.[6] Deep learning models can also identify defects which would be difficult to detect otherwise. When consistent images become challenging because of

different reasons, deep learning can account for those variations and learn valuable features to make the inspections robust.

E. Elimination of the need for data labeling

Data labeling can be a costly and tedious job. With a deep learning approach, the requirement for well-marked data becomes obsolete as the algorithms exceed expectations at learning with no rule. [10] Different sorts of AI approaches aren't nearly as successful as this kind of learning.

III. EVOLUTION OF DEEP LEARNING AN OVERALL TIMELINE OF DEEP LEARNING

There have been several major developments in the field of Deep Learning over the past 60 years. [13] To conclude it down, Evolution of Deep Learning look like:

- 1960s: Shallow neural networks
- 1960-70s: Back propagation emerges
- 1974-80: First AI Winter
- 1980s: Convolution emerges
- 1987-93: Second AI Winter
- 1990s: Unsupervised Deep learning
- 1990s-2000s: Supervised Deep Learning back en vogue
- 2006s-present: Modern deep learning

Following table depicts about the overall timeline and history of Deep Learning.

Year	Advancement in the field of Deep Learning
1943	**The first mathematical model of a Neural Network - By Walter Pitts and Warren McCulloch** Walter Pitts, a logician, and Warren McCulloch, a neuroscientist proposed a combination of science and algorithms that intended to imitate human thought processes. [11]
1950	**The prediction of Machine Learning - By Alan Turing** Alan Turing proposed a machine that can learn from experience and even hinting the genetic algorithms in his paper "Computing Machinery and Intelligence." He invented the "The Turing Test" which was designed to test a machine that it can think or not
1952	**First Machine Learning programs - By Arthur Samuel** Arthur Samuel invented and coined the term "machine learning" in 1952. He is also known as the father of Machine Learning. [14]
1957	**Setting the foundation for Deep Neural Networks - By Frank Rosenblatt** Rosenblatt, a psychologist, submitted a paper entitled "The Perceptron: A Perceiving and Recognizing Automaton" to Cornell Aeronautical Laboratory in 1957. [16]
1959	**Discovery of Simple Cells and Complex Cells - By David H. Hubel and Torsten Wiesel** In 1959, neurophysiologists and Nobel Laureates David H. Hubel and Torsten Wiesel discovered two types of cells in the primary visual cortex: simple cells and complex cells. Many ANNs (Artificial Neural Networks) are inspired by these observations.

1965	**The first working Deep Learning Networks - By Alexey Ivakhnenko and V.G. Lapa** Mathematician Ivakhnenko and associates including Lapa arguably created the first working deep learning networks in 1965, by implementing all the theories present at that point of time. [12]
1986	**Improvements in Shape Recognition and Word Prediction - By David Rumelhart, Geoffrey Hinton, and Ronald J. Williams** In a 1986 paper entitled "Learning Representations by Back-propagating Errors," Rumelhart, Hinton, and Williams described in greater detail the process of back propagation
1989	**Q-learning - By Christopher Watkins** Watkins published his PhD thesis – "Learning from Delayed Rewards" – in 1989. In it, he introduced the concept of Q-learning, which greatly improves the practicality and feasibility of reinforcement learning in machines
1997	**Long Short-term Memory - By Jürgen Schmidhuber and Sepp Hochreiter** A recurrent neural network framework, Long Short-Term Memory (LSTM) was proposed by Schmidhuber and Hochreiter in 1997. Both of them increased and improved the performance and accuracy of recurrent neural networks by eliminating the long-term dependency problem.[15]
2009	**Launch of ImageNet - By Fei-Fei Li** A professor and head of the Artificial Intelligence Lab at Stanford University, Fei-Fei Li launched ImageNet in 2009. As of 2017, it's a very large and free database of more than 14 million (14,197,122 at last count) labeled images available to researchers, educators, and students.
2012	**The Cat Experiment** This "Cat Experiment" was a major step forward in the field of Deep Learning. Using a neural network spread over thousands of computers, the team presented 10,000,000 unlabeled images – randomly taken from YouTube – to the system and allowed it to run analyses on the data.
2014	**Deep Face and Generative Adversarial Networks (GAN)** Developed and released to the world in 2014, the social media behemoth's deep learning system – nicknamed Deep Face – uses neural networks. In the year 2014, Generative adversarial networks were introduced which empower models to handle unsupervised learning, which is more or less the ultimate objective in the artificial intelligence network.[17]
2016	**Powerful Deep Learning products** Cray Inc., as well as many other businesses like it, is now able to offer powerful Deep learning products and solutions by using Microsoft's neural-network software which performs deep learning tasks on data in a fraction of the time they used to take – hours instead of days.

IV. WORKING METHODOLOGY

The important feature of an Activation function is that it should be differentiable. [18] We need it to be this way so as to perform backpropogation optimization strategy while propagating backwards in the network to compute gradients of Error (loss) with respect to Weights and then accordingly optimize weights using Gradient Descend or any other Optimization technique to reduce error. Along with better learning algorithms, introduction of greater activation functions and better initialization methods help us to create better neural networks.

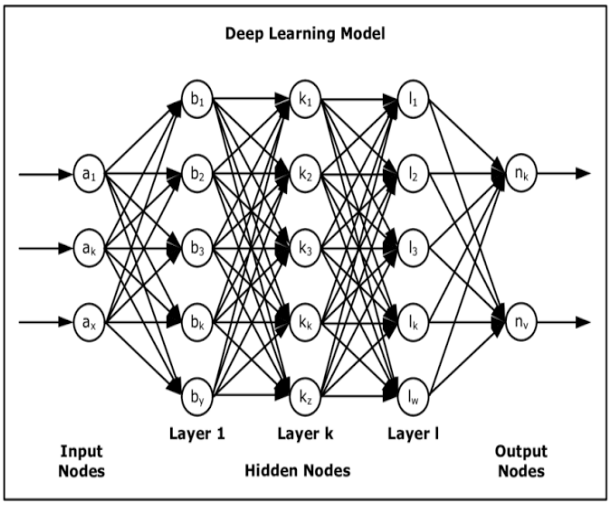

Figure 1: A model explaining the working method in Deep Learning technology.

V. CONCLUSION

Deep neural networks can deliver significant benefits to businesses; in fact, many businesses are taking advantage of deep learning for more effective pattern recognition, recommendation engines, translation services, fraud detection and more. For Deep Learning, it comprises matrix multiplications. This means that deep learning algorithms can be massively parallelized, and will profit from future improvements from what remains of Moore's Law. A need for deep learning open-source projects will be felt, and changes in the type of intelligence that humans will need to develop in the future will happen, as knowledge will become a commodity. The breadth of function and utility for existing deep learning technologies is already considerable. But its potential uses are even more varied and quite remarkable.

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