

THE DEPTH OF DEEP LEARNING

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ABSTRACT

Deep learning is one of most powerful computational models compared to machine learning methods. It has the ability to allow an algorithm to learn large set of data for a particular behavior and define a set of rules explicitly. In today's scenario, the use of the internet has opened the floodgates of data. Collecting and analyzing data based on domain-specific information is more complex. Deep Learning (DL), an unsupervised approach, can be utilized to understand complex patterns, data tagging, semantic indexing, information retrieval, data streaming, image classification, speech recognition, and information security.

Key words : Deep learning, Machine learning.

I. INTRODUCTION

Building up of multiple processing layers of abstraction to understand and analyze data is called deep learning. In other words, deep learning is a form of machine learning which learns automatically in terms of hierarchy of terms [1]. Deep learning requires no manual force to provide the information required to learn the representation. It learns the representation by developing or building a hierarchy of concepts forming many deep layers.

Deep learning involves forming a computation model with a combination of artificial intelligence and multi-layered neural network concepts. The artificial intelligence provides the basic platform as deep learning starts to learn or understand the data automatically as graph-hierarchy of layers are formed by means of neural networks. It results in extending the research in developing algorithms for hierarchical and layered architectural model to represent and learn data with more abstract information.

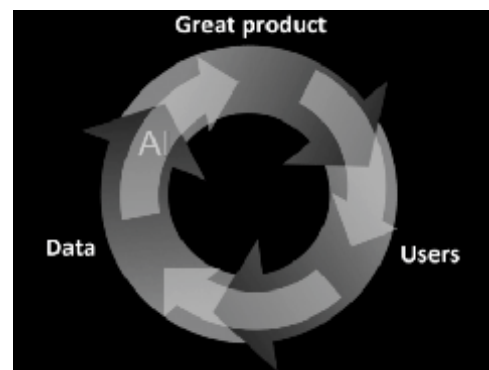


Fig. 1. Virtuous circle of AI

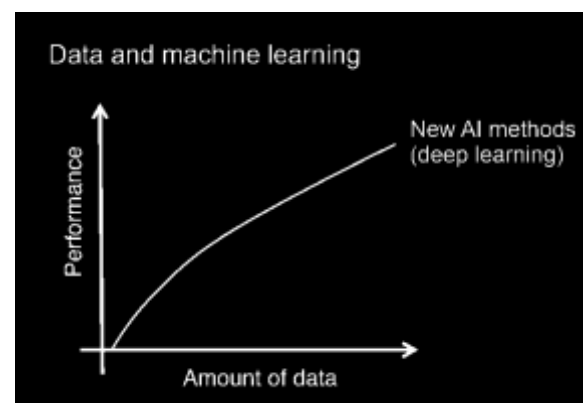


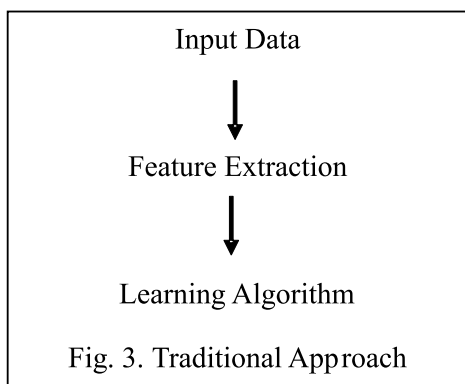
Fig. 2. Performance of DL and ML methods

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According to Andrew Ng, "Deep Learning is a superpower. With it you can make a computer see, synthesize novel art, translate languages, render a medical diagnosis, or build pieces of a car that can drive itself." Fig. 1. and Fig. 2. depict a pictorial representation of the influence of artificial intelligence in deep learning and the performance of deep learning and machine learning methods.

Machine Learning and Deep Learning

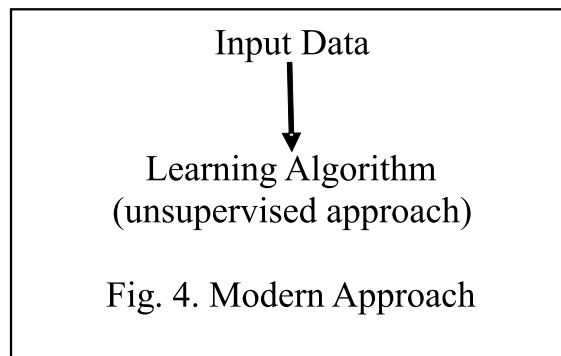
Machine learning is a shallow approach as it requires a manual feature extraction process, where-as deep learning extracts the required information or features automatically. The performance of machine learning converges when the size of data grows large, but deep learning performance diverges for massive data. Fig. 3. depicts a traditional or shallow approach using feature extraction methods and Fig. 4. depicts a modern approach without feature extraction methods and with unsupervised learning methods.



Computing or analyzing a large amount of unsupervised data by deep learning is more efficient, and data representation can be learned by greedy layer-wise manner [2-3].

This paper discusses the basic architecture of deep learning and its application. Section 2 discusses the architecture of deep learning. Section 3 focuses on the

impact of deep learning in various fields and Section 4 concludes the paper.



2. THE ARCHITECTURE OF DEEPLARNING

The basic structure of neural network consists of a series of neurons which are simple and, connected processors that produce real valued activations. The main components involved in DL-based methods are model, data, objective and an optimization procedure [4] as in Fig. 5.

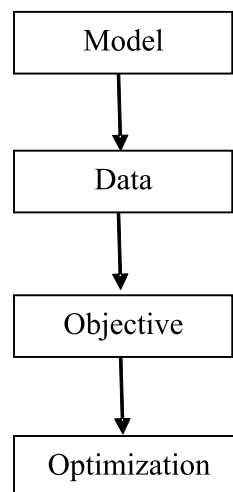


Fig. 5. Components of DL methods

A model is a function representing high dimensional data mapping against target data holding lower dimensional space. Data are inputs to deep learning approaches. They can be of different types such as, sequential data, spatial data, text data, structured data

and, multi-modal data. Understanding, defining and learning parameters required for DL methods/approaches are the objectives of the function.

Architectural components are fully connected layers (FC), convolutional layers (CO), recurrent layers (RE) and generative adversarial networks (GAN). The process of learning procedure to perform actual learning is known as optimization procedure.

DL model can be represented mathematically (1) as:

$$y = f(x) \quad (1)$$

where, x is input, y is output and f represent parameterized function.

Some of the architecture models are Generative Adversarial Networks (GANs) [5], deep Boltzmann Machines [6] and, attention mechanisms for RNNs[7].

3. THE INFLUENCE OF DL METHODS

Li et al. used DL-based learning methods and spectral clustering algorithms over mobile devices to perform Speech forensics. [8]. A combined method had obtained better classification accuracy of 94.1% of all possible combinations. Deep neural network was proposed by Ye et.al. for Image steganalysis to detect information stored or hidden in the image [9]. Convolutional neural network was proposed by Kandi et.al. to add an invisible watermark to image [10]

High sensitivity and specificity were obtained for detecting diabetic retinopathy in retinal fundus photographs using DL based methods [1]. Deep learning generative model was applied over documents to learn generative model [11]. Online data, both non-stationary and streaming data, were generalized by introducing adaptive deep belief networks [12]. DL method was preferred by Glorot et al. [13] to a

hierarchical learning manner to identify intermediate data representations.

4. CONCLUSION

Artificial intelligence with deep learning methods combines representation learning with complex reasoning and has widened the scope for various fields providing new paradigms to the existing problems. DL-based methods provide a certain degree of simplification for information security [4], cheminformatics [14-15], speech and handwriting recognition [16], Big Data Analytics [17], tasks and other related areas.

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