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Introduction to loose coupling approach towards deep learning

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Abstract

Deep learning algorithms are an emerging methods of machine learning, that aim to tackle a wide variety of applied problems especially related to artificial intelligence, neural networks, natural language processing and it is used at discovering multiple levels of distributed representations. Similarly, to machine learning algorithms, the mentioned deep learning algorithms have been applied by using supervised, semi-supervised and unsupervised learning strategies in order to learn multi-agent systems and features in distributed architectures for clustering, classification, and pattern recognition tasks.

This paper aims to review the main key features of deep learning algorithms by using loose coupling approach. Firstly, it illustrates an overview of deep learning applications, and then describes their key features in diverse applied problems. In conclusion, the given paper summarizes the emerging developings and challenges in designing and training deep neural networks.

Keywords: Data Science, Machine Learning, Deep Learning, Algorithms, Neural Network, Artificial Intelligence
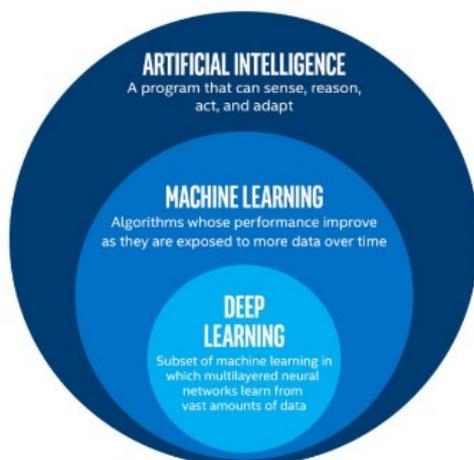
1 Introduction

FIGURE 1 The realtion between ML DL and AI [5]

As shown in the graph above, Deep Learning has been applied mostly to model deeply and process neural networks and lying on Machine Learning algorithms.

According to Herbert Simon (1970), "Learning is any process by which a system improves performance from experience".

Deep Learning is a set of Machine Learning (ML) algorithms that based on a learning of multi layer newral networks, graphical probability models. Additionally, Deep Learning (DL) can be served as one of the main methods of Machine Learning (ML).

By Kwang Gi Kim, **"**Deep learning enables computers to learn from experience and understand the world in terms of a hierarchy of concepts [7].**"**

The term of "Deep Learning" appeared in the 1980s, but until 2012 for the implementation of this technology was not enough capacity in the field of artificial intelligence. After a series of articles by famous scientists, publications in scientific journals, the technology quickly became popular.

Deep learning mimics the abstract thinking of a person, also it is able to generalize. For instance, a neural network that is machine-trained does not recognize handwritten letters very well and so that it does not get confused in different spellings, they must all be loaded into it. Moreover, deep learning is used in the case of multilayer artificial neural networks and will be able to cope with this task.

2 Overview

Most projects with deep learning are used in photo recognition or audio, diagnostics of diseases. For example, it is already used in Google translations from the image: Deep Learning technology allows you to determine if there are letters in the picture and then translate them.

Another project that works with photos is a face recognition system called "DeepFace". Moreover, it can recognize human faces with an accuracy of about 97.25% the same accuracy as a person.

"WaveNet" system has been released in 2016 by Google company that can imitate human speech. In order to do this, the company downloaded millions of minutes of recorded voice requests into the system, which were used in the project called "OK Google", and after studying, the neural network was able to make sentences with proper accents, accent and without illogical pauses.

At the same time, deep learning can semantically segment an image or video - that is, it is not just to designate

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that there is an object in the picture, but also to perfectly highlight its contours. This technology is used in unmanned vehicles, which determine whether there is interference on the road, marking and read information from traffic signs to avoid accidents. The neural network is also used in medicine in order to determine diabetic retinopathy from photographs of the eyes of patients.

A system based on deep learning called "Let there be color! [4]", for example, helps to give color to a black-white photo and even video. Ultra precise neural networks compute all the nuances of an image and divide it into layers to determine color depth and transitions. As photos are processed, the system is being trained by deep learning and can now process old photos and even video materials as shown below [3].

FIGURE 2 Photos have been processed by deep learning algorithms [4]

A neural network is a trainable system, and it acts not only on the basis of the given algorithms, but also on its own experience.

A neuron in deep learning can be thought of as a "black box" with many input holes and one output. At the input, the neuron receives signals and forms an output based on them.

Any neural network consists of multiple layers. Each next layer creates new attributes based on those that the previous layer gave it. For example, it is necessary for the computer to recognize the cat in the photo. We collect data millions of photos of cats and give (feed) this data to the algorithm.

There can be a lot of layers, but imagine that you need only 4 to solve the problem. Each input of the first layer of neurons receives an incoming pixel of the picture [2].

In addition, each subsequent layer combines the information obtained at the previous levels. The first layer of neurons can recognize only lines, points and circles, when the first layer of neurons understands where these objects are in the photo, it transfers the information to the next layer.

Based on this data, the algorithm claims that the second layer will be able to distinguish triangles and squares, for example, to understand where a cat has ears, when the third layer finds out about it, it might understand where the image is, and where the body of the given cat [2].
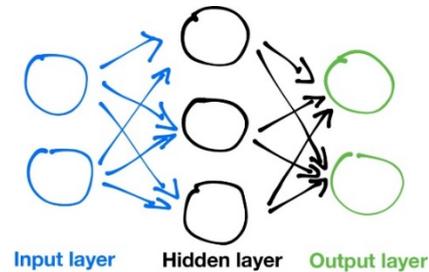

FIGURE 3 Neural Networks [2]

According to Carlos E. Perez [1], the numerous methods that lead to weak communication (loose coupling approach) between neurons are divided into the three main categories such as mediation, decomposition and late binding. The mentioned categories usually reduce the dependence of the signal, computational dependence and temporal dependence.

The first type leads to decomposation of one component into several components of neural network. The second type leads to mediation that intermediate component of neural network can be placed between two interacting components. Finally, there is a late binding method among neurons.

3 Conclusion

Statement by Andrew Yeng says [6], "If the human mind is able to find a solution to a problem in a few seconds, there is a high probability of speeding up the process." This developer calls Deep Learning as the "new electricity", comparing with the main breakthrough of humanity. Most likely, those companies that will not introduce deep learning will soon feel themselves far behind competing companies.

Deep learning, in fact, has widely introduced machine learning into practice. It breaks up tasks so that all kinds of machine assistance seem possible such as cars without drivers, the best preventive health care, film recommendations - all this is already have been implemented.

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