Orissa Journal of Physics
ISSN 0974-8202

Vol. 27, No.2 –
Vol. 29, No. 1
Aug. 2020 – Feb. 2022
pp. 39-45

Machine Learning in Big Data Analytics and Artificial Intelligence

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Received 7.11.21, Accepted 17.12.21

Abstract : The possibility of this research paper is to create attentiveness among upcoming scholars about recent advances in technology, specifically deep learning an area of machine learning which finds applications in big data analytics and artificial intelligence. Big Data Analytics and Deep Learning are two high-focus of data science. Big Data has become important as many organizations both public and private have been collecting massive amounts of domain-specific information, which can contain useful information about problems such as national intelligence, cyber security, fraud detection, marketing, and medical informatics. Companies such as Google and Microsoft are analyzing large volumes of data for business analysis and decisions, impacting existing and future technology. Deep Learning algorithms extract high-level, complex abstractions as data representations through a hierarchical learning process. A key benefit of Deep Learning is the analysis and learning of massive amounts of unsupervised data, making it a valuable tool for Big Data Analytics where raw data is largely unlabeled and un-categorized. In the present study, we explore how Deep Learning can be utilized for addressing some important problems in Big Data.

Key Words: Machine Learning, Deep Learning, Big Data, Artificial Intelligence.

1. Introduction

Machine learning, by its definition, is a field of computer science that evolved from studying pattern recognition and computational learning theory in artificial intelligence. It is the learning and building of algorithms that can learn from and make predictions on data sets. These procedures operate by construction of a model from example inputs in order to make data-driven predictions or choices rather than following firm static program instructions.[1]

"A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E." -- Tom Mitchell, Carnegie Mellon University.

So if we want our program to foresee, for example, traffic forms at a busy node (task T), we can run it through a machine learning process with data about previous traffic patterns (experience E) and, if it has successfully "learned", it will then do better at predicting upcoming traffic patterns (performance measure P).[1,2]

We need machine learning in the following cases:

- Human expertise is absent. E. g. Navigating on Mars.
- Humans are unable to explain their expertise. E. g. Speech Recognition.
- Solution changes with time E. g. Temperature Control.
- Solution needs to be adapted to particular cases. E. g. Biometrics.
- Problem size is too vast for our limite capabilities. E. g. Calculating webpage ranks.

Consider the recognition of spoken speech, where an acoustic speech signal is converted to ASCII text. The pronunciation of a word may vary from person to person due to differences in age, gender or pronunciation, so in machine learning, the approach is to collect a large collection of sample utterances from diverse people and learn to plot these to words. As another example, consider routing packets over a computer grid. The trail maximizing the quality of service from source to destination changes regularly as the system traffic changes. A learning routing procedure is able to adapt to the best path by monitoring the network traffic.[2,3]

Machine learning involves two types of tasks:

- **Supervised machine learning:** on a pre-defined set of "training examples", which then facilitate its ability to reach an accurate conclusion when given new data.
- **Unsupervised machine learning:** bunch of data and must find patterns and relationships.

Consider a situation wherein we need a machine learning algorithm to make predictions. Our predictor is of the form $h(x) = \theta_0 + \theta_1 x$

Where θ_0 and θ_1 are constants. For every training example with x as input, there is a corresponding output y which is known in advance. We compare values obtained from the predictor with the output y and try to minimize any differences in values by altering θ_0 and θ_1. After multiple examples have been used for training, we are left with the optimized equation. Now, if we provide an input whose value is unknown, the predictor function will be able to give us an almost accurate estimate.[3]

2. Deep Learning

A new area of machine learning research, which has been introduced with the objective of moving machine learning closer to one of its original goals: Artificial Intelligence.

Deep learning draws its roots from Neocognitron; an Artificial Neuron Network (ANN) introduced by Kunihiko Fukushima in 1980. An ANN is an interconnected network of processing units emulating the network of neurons in the brain. The idea behind ANN was to develop a learning method by modeling the human brain. However, this method lost machine learning community owing to the fact that it required an impractical amount of time as well as a humungous amount of data to train the network parameters for any decent application. Deep learning is a method to train multi (and hence the word “deep”) ANN using little data. This is the reason why ANN is back in the game. Using an example to compare Machine Learning with Deep Learning, we can say that if a machine learning algorithm learns parts of a face like eyes and nose for face detection tasks, a deep learning algorithm will learn extra features like the distance between eyes and the length of the nose. Hence Deep major step away from Shallow Learning Algorithms.[3,4]

The term deep learning gained traction in mid “vanishing gradient problem” responsible reduction in speed was solved in a publication Hinton and Ruslan Salakhutdinov. They showed layered feed forward neural network could retrained at a time, treating each layer unsupervised restricted Boltzmann’s machine, then using supervised back-propagation for fine tuning.

A Deep Neural Network (DNN) (Figure 1) is defined to Neural Network (ANN) with at least one hidden Layers of units between the input and output layers.added levels of abstraction, thus capability. The most popular kinds are known as Convolutional Neural ConvNets (Figure 2). These area type of feed network, extensively used in computer individual neurons are tiled in such overlapping regions in the visual field have also been successfully applied recognition (ASR). Deep Belief Networks

Deep Belief Networks are some other popular deep learning architectures in use.[4]

There are two disadvantages with DNNs. and computation time. Overfitting very specific details on the training layers. As a result, the DNN performs is given as input, but poorly when This problem is solved by a regularization where some units are the hidden layers during training. computations required here are well we could speed up the computations enormous processing power.

The figure below illustrates how images can be achieved using a deep every layer learns a single feature at can learn the different edges; in slightly more complex features like such as ears, noses and eyes. In the even more complex features like the face shapes. The final representations applications of categorization.

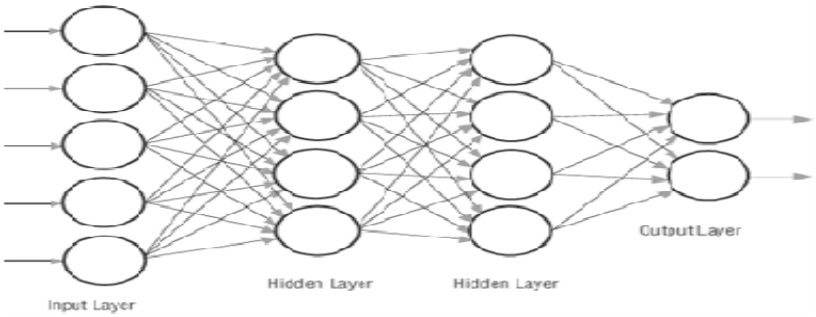

Fig. 1. Deep Neural Network architecture

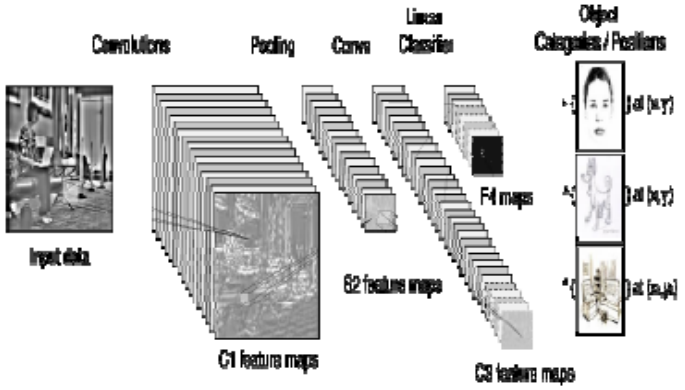

Fig. 2 . Convolutional Neural ConvNet architecture

Applications of deep learning are as follows:-

- Optical Character Recognition E.g. Scanning an image an extracting text from it.
- Speech Recognition E. g. Generating textual representation of speech from a sound clip.
- Artificial Intelligence E. g. Robotic Surgery
- Automotive Applications E. g. Self-Driving Cars
- Military and Surveillance E. g. Drones

3. Deep Learning in Big Data

Deep Learning and Big Data are two high-focus areas of data science. Deep learning algorithms extract complex data patterns, through a hierarchical learning process by analyzing and learning massive amounts of unsupervised data (Big Data). This makes it an extremely valuable tool for Big Data Analyzers.

Big Data has 4 important characteristics, namely, Volume, Variety, Velocity and Veracity. They are learning algorithms are mainly concerned with issues related to Volume and Variety. Deep Learning algorithms deal with massive amounts of data, i. e. Volume whereas shallow learning algorithms fail to understand complex data patterns which are inevitably present in large data sets. Moreover, Deep Learning deals with analyzing raw data presented in different formats from different sources, i. e. Variety in Big Data. This minimizes the need

for input from human experts to retrieve features from all new data types found in Big Data.[5]

Semantic Indexing, Data Tagging and Fast Information Retrieval are the main objectives of Deep Learning in Big Data. Consider data that is unstructured and unorganized. Haphazard storage of massive amounts of data cannot be used as a source of knowledge because looking through such data for specific topics of interest and retrieving all relevant and related information would be a tedious task. Using Semantic Indexing and Data Tagging, we identify patterns in the relationships between terms and concepts based on the principle that words used in the same context have similar meanings. The related words can then be stored close to each other in the memory. This helps us present data in a more Comprehensive manner and helps in improving efficiency. A direct result of such a form of storage would be that search engines would work more quickly and efficiently.[6]

4. Deep Learning in Artificial Intelligence

Artificial Intelligence is the theory and development of computers which are capable of performing tasks which humans can. Deep learning represents the rudimentary level of attempts towards achieving this task. It is utilized in visual perception, speech recognition, game playing, expert systems, decision-making, medicine, aviation and translation between languages.6,7]

In the gaming industry, Artificial Intelligence could be useful as we could have a ‘gamebot’ stand as an opponent when a human player is not available. We could also have deep learning algorithms suggest how enemy spawns could be strategically placed in the arena to obtain different levels of difficulty. The military as well as aviation industries can use Artificial intelligence to sort information related to air traffic and then provide their pilots with the best techniques to avoid the traffic. A medical clinic can use Artificial Intelligence systems to organize bed schedules, staff rotations and provide medical information.[8]

5. Conclusion

Deep learning techniques have been criticized because there is no way of representing causal relationships (such as between diseases and their symptoms), and the algorithms fail to acquire abstract ideas like “sibling” or “identical to.”

Not much theory is available for most of the methods which is disadvantageous to beginners.

Deep Learning is only a small step towards building machines which have human-like intelligence. Further advancements must be made in order to achieve our ultimate goal. Organizations like Google,Facebook, Microsoft and Baidu (a Chinese search engine) are buying into this technology and exploring various avenues available. For example, Facebook is using deep learning to automatically tag uploaded pictures.

Google's Deep Mind focusses on exploring new techniques in this area. Recent trends show that the interest in machine learning has only been growing with time and has sparked an interest in countries like India and Singapore. Thus it has emerged as one of the most promising fields of technology in recent times.

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