Chapter 91
An Investigation Into the Efficacy of Deep Learning Tools for Big Data Analysis in Health Care

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ABSTRACT

This article describes how machine learning (ML) algorithms are very useful for analysis of data and finding some meaningful information out of them, which could be used in various other applications. In the last few years, an explosive growth has been seen in the dimension and structure of data. There are several difficulties faced by conventional ML algorithms while dealing with such highly voluminous and unstructured big data. The modern ML tools are designed and used to deal with all sorts of complexities of data. Deep learning (DL) is one of the modern ML tools which are commonly used to find the hidden structure and cohesion among these large data sets by giving proper training in parallel platforms with intelligent optimization techniques to further analyze and interpret the data for future prediction and classification. This article focuses on the use of DL tools and software which are used in past couple of years in various areas and especially in the area of healthcare applications.

DOI: 10.4018/978-1-7998-1204-3.ch091

INTRODUCTION

Machine learning (ML) is a field of study which learns the behaviour of functional relationship among data without considering the detail underlying characteristics present in them. These techniques are applied to derive the functional attributes of underlying data which do not contain precise definition about them. In real cases, the datasets which are available do not have a precise definition and functional co-relation. So, ML algorithms are used appropriately for these types of data which are capable to infer the useful features of the data and their functional co-relationship so that they can be used in the problems of classification, clustering and prediction etc. Deep learning (DL) is a field of study under the umbrella of Machine learning (ML) which is constituted on the algorithms inspired by the structure and utility of human brain. This study is coherent to artificial neural network (ANN) and can be called as advanced ANN having higher set of problem solving capability and utility. DL refers to a special type of ANN which is constituted by multiple numbers of hidden layers. The hidden layers are responsible for handling nonlinearity and complexity of underlying data. These are mainly useful for giving training to network exhibiting complex co relational functions and behaviour and are mostly suitable for large data sets. Due to this reason these are very successfully applied to big data domain. In this contemporary era, data is highly scalable and growing exponentially. There is a parallel growth in data reproduction, availability and access and abundance high speed computers. So, the need of the hour is to develop high speed large neural network which are scalable enough to deal with plethora amount of big data. The input to the conventional shallow learning algorithms are known features from the data, but DL algorithms possess the potential to extract the representative feature available from the raw data whose sources are social media, transactional data, business houses, etc.

In most application of data like classification, clustering and prediction the common work flows for machine algorithms are built on some basic steps like: (i) data cleaning (ii) pre-processing (iii) training which build the learning model and (iv)testing which will evaluate the built model. For these problems the input space contains a set of input data sample x_i (i = 1, 2, ..., n ; where n is the number of input instances which is a vector of 'm' dimension where m is the number of features) and output y_i . In supervised algorithms the artificial model learns to derive a mapping function f(x) = y from a priory known pair of (x_i, y_i). After the model is duly trained on the basis of known input-output pairs (x_i, y_i), it is evaluated against the unknown samples to infer the target output which is called as testing.

In the case of unsupervised model, the model has to explore the pattern exhibiting in input x_i to find out y_i. In the training phase output y_i is not provided to the model, it has to find itself. Clustering and principal component analysis are some of the examples of unsupervised learning.

Deriving feature sets x_i to build an input dataset is very time consuming and problem specific. These are less available and difficult to create for every problem. This is the reason for unsuitability of supervised and unsupervised algorithm in all problems. But deducting the principal feature from a data set is directly associated with the performance of a learning algorithm. If features are correctly fetched from the data, then learning will take less time and the model shows higher level of accuracy. In the other hand for high dimensional data containing big data components, it is almost impossible to find out all the informative and relevant features from the raw data. This is a major limitation behind using conventional machine learning algorithms in big data possessing high dimensional feature data. This limitation is overcome by the emergence of deep neural network (Bengio et al., 2013; LeCun et al., 2015). Deep neural network contains many layers containing more than one hidden layer (Oliveira et al., 2016). The input layer takes the high dimensional raw data and extracts the relevant representive