International Journal in Management and Social Science
Volume 09 Issue 10, October 2021 ISSN: 2321-1784 Impact Factor: 6.319
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

BIG DATA DEEP LEARNING: CHALLENGES AND PERSPECTIVES

PUNAM PRABHAKER SALUNKHE
Research Scholar, Sunrise University, Alwar, Rajasthan
DR. SUMIT BHATTACHARJEE
Research Supervisor, Sunrise University, Alwar, Rajasthan

ABSTRACT

Deep learning is currently an extremely active research area in machine learning and pattern recognition society. It has gained huge successes in a broad area of applications such as speech recognition, computer vision, and natural language processing. With the sheer size of data available today, big data brings big opportunities and transformative potential for various sectors; on the other hand, it also presents unprecedented challenges to harnessing data and information. As the data keeps getting bigger, deep learning is coming to play a key role in providing big data predictive analytics solutions. In this paper, we provide a brief overview of deep learning, and highlight current research efforts and the challenges to big data, as well as the future trends. In this paper we bridge the gap between deep learning and mobile and wireless networking research, by presenting a comprehensive survey of the crossovers between the two areas. We first briefly introduce essential background and state-of-theart in deep learning techniques with potential applications to networking. We then discuss several techniques and platforms that facilitate the efficient deployment of deep learning onto mobile systems. Subsequently, we provide an encyclopedic review of mobile and wireless networking research based on deep learning, which we categorize by different domains. Drawing from our experience, we discuss how to tailor deep learning to mobile environments. We complete this survey by pinpointing current challenges and open future directions for research.

Keyword: Deep learning, Wireless, Network, Data, Application, Challenges

INTRODUCTION

Two of the most exciting developments in today's ever-expanding digital landscape are deep learning and Big Data. Big Data may mean many things to different people, but in this context it refers to the massive amounts of digital information that are becoming more popular yet are exceeding the capacity of traditional data management and analysis systems. The volume, variety, and velocity of data stored digitally are all expanding at breathtaking speeds. According to the NSA, for instance, the Internet processes 1,826 Petabytes of data every single day. The quantity of digital information in the globe has increased by a factor of nine since 2011, reaching an estimated 25 trillion gigabytes by the end of this year. Businesses, the healthcare industry, manufacturers, and the educational services are just few of the sectors that stand to benefit greatly from the digital data boom. Furthermore, this causes a significant change in the way we conduct scientific studies, with an emphasis on data-driven discovery.

The term "deep learning" is used to describe a set of machine learning algorithms that automatically learn hierarchical representations in deep architectures for classification, as opposed to the more traditional "shallow-structured learning architectures" used by most traditional learning methods. Because of its state-of-the-art performance in many research domains, such as speech recognition, collaborative fultering, and computer vision, deep learning has attracted much attention from the academic community in recent years. This trend was inspired by biological observations on human brain mechanisms for processing of natural signals. Industry goods that make use of the abundant digital data have also benefited from the use of deep learning. Google, Apple, and Facebook are just a few examples of companies that gather and analyse vast quantities of data on a daily basis, and all three have been pushing forward deep learning-related initiatives with great vigour. For instance, Apple's Siri, the virtual personal assistant in iPhones, uses deep learning and more and more data gathered by Apple services to provide a broad range of services, such as weather updates, sport news, replies to user inquiries, reminders, etc.

With the rise in data volume and the improvements in processing power and graphics processors, deep learning is rising to the forefront as a solution provider for big data predictive analytics. Our purpose here is not to provide an exhaustive review of the field of deep learning; rather, we hope to shed light on some of the most pressing concerns surrounding the use of large datasets for learning, discuss some of the current research being done in this area, discuss some of the obstacles facing big data, and look ahead at some of the emerging trends in this area.

LITERATURE REVIEW

Mehdi Mohammadi (2018) In the era of the Internet of Things (IoT), an enormous amount of sensing devices collect and/or generate various sensory data over time for a wide range of fields and applications. Based on the nature of the application, these devices will result in big or fast/real-time data streams. Applying analytics over such data streams to discover new information, predict future insights, and make control decisions is a crucial process that makes IoT a worthy paradigm for businesses and a quality-of-life improving technology. In this paper, we provide a thorough overview on using a class of advanced machine learning techniques, namely deep learning (DL), to facilitate the analytics and learning in the IoT domain. We start by articulating IoT data characteristics and identifying two major treatments for IoT data from a machine learning perspective, namely IoT big data analytics and IoT streaming data analytics. We also discuss why DL is a promising approach to achieve the desired analytics in these types of data and applications. The potential of using emerging DL techniques for IoT data analytics are then discussed, and its promises and challenges are introduced. We present a comprehensive background on different DL architectures and algorithms. We also analyze and summarize major reported research attempts that leveraged DL in the IoT domain. The smart IoT devices that have incorporated DL in their intelligence background are also discussed. DL implementation approaches on the fog and cloud centers in support of IoT applications are also surveyed. Finally, we shed light on some challenges and potential directions for future research. At the end of each section, we highlight the lessons learned based on our experiments and review of the recent literature.

Yaguo Lei (2016) Intelligent fault diagnosis is a promising tool to deal with mechanical big data due to its ability in rapidly and efficiently processing collected signals and providing accurate diagnosis results. In traditional intelligent diagnosis methods, however, the features are manually extracted depending on prior knowledge and diagnostic expertise. Such processes take advantage of human ingenuity but are time-consuming and labor-intensive. Inspired by the idea of unsupervised feature learning that uses artificial intelligence techniques to learn features from raw data, a two-stage learning method is proposed for intelligent diagnosis of machines. In the first learning stage of the method, sparse filtering, an unsupervised two-layer neural network, is used to directly learn features from mechanical vibration signals. In the second stage, softmax regression is employed to classify the health conditions based on the learned features. The proposed method is validated by a motor bearing dataset and a locomotive bearing dataset, respectively. The results show that the proposed method obtains fairly high diagnosis accuracies and is superior to the existing methods for the motor bearing dataset. Because of learning features adaptively, the proposed method reduces the need of human labor and makes intelligent fault diagnosis handle big data more easily.

Qingchen Zhang (2018) Deep learning, as one of the most currently remarkable machine learning techniques, has achieved great success in many applications such as image analysis, speech recognition and text understanding. It uses supervised and unsupervised strategies to learn multi-level representations and features in hierarchical architectures for the tasks of classification and pattern recognition. Recent development in sensor networks and communication technologies has enabled the collection of big data. Although big data provides great opportunities for a broad of areas including e-commerce, industrial control and smart medical, it poses many challenging issues on data mining and information processing due to its characteristics of large volume, large variety, large velocity and large veracity. In the past few years, deep learning has played an important role in big data analytic solutions. In this paper, we review the emerging researches of deep learning models for big data feature learning. Furthermore, we point out the remaining challenges of big data deep learning and discuss the future topics.

CharithPerera (2014) The Internet of Things (IoT) is a dynamic global information network consisting of Internet-connected objects, such as radio frequency identifications, sensors, and actuators, as well as other instruments and smart appliances that are becoming an integral component of the Internet. Over the last few years, we have seen a plethora of IoT solutions making their way into the industry marketplace. Context-aware communications and computing have played a critical role throughout the last few years of ubiquitous computing and are expected to play a significant role in the IoT paradigm as well. In this paper, we examine a variety of popular and innovative IoT solutions in terms of context-aware technology perspectives. More importantly, we evaluate these IoT solutions using a framework that we built around well-known context-aware computing theories. This survey is intended to serve as a guideline and a conceptual framework for context-aware product development and research in the IoT paradigm. It also provides a systematic exploration of existing IoT products in the marketplace and highlights a number of potentially significant research directions and trends.

ZahangirAlom (2019) In recent years, deep learning has garnered tremendous success in a variety of application domains. This new field of machine learning has been growing rapidly and has been applied to most traditional application domains, as well as some new areas that present more opportunities. Different methods have been proposed based on different categories of learning, including supervised, semi-supervised, and un-supervised learning. Experimental results show state-of-the-art performance using deep learning when compared to traditional machine learning approaches in the fields of image processing, computer vision, speech recognition, machine translation, art, medical imaging, medical information processing, robotics and control, bioinformatics, natural language processing, cybersecurity, and many others. This survey presents a brief survey on the advances that have occurred in the area of Deep Learning (DL), starting with the Deep Neural Network (DNN). The survey goes on to cover Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), including Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRU), Auto-Encoder (AE), Deep Belief Network (DBN), Generative Adversarial Network (GAN), and Deep Reinforcement Learning (DRL). Additionally, we have discussed recent developments, such as advanced variant DL techniques based on these DL approaches. This work considers most of the papers published after 2012 from when the history of deep learning began. Furthermore, DL approaches that have been explored and evaluated in different application domains are also included in this survey. We also included recently developed frameworks, SDKs, and benchmark datasets that are used for implementing and evaluating deep learning approaches. There are some surveys that have been published on DL using neural networks and a survey on Reinforcement Learning (RL). However, those papers have not discussed individual advanced techniques for training large-scale deep learning models and the recently developed method of generative models.

International Journal in Management and Social Science
Volume 09 Issue 10, October 2021 ISSN: 2321-1784 Impact Factor: 6.319
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

Deep Learning Driven Networking Applications

There is an increasing body of literature that provides overviews of current efforts that use deep learning to the field of computer networking. When it comes to mobile analytics, Alsheikh et al. highlight both the advantages and disadvantages of employing large data, and they offer a Spark-based deep learning system. Wang and Jones highlight the research issues associated with network intrusion detection and cover assessment criteria, data streaming, and deep learning approaches. To improve QoE in 5G networks, Zheng et al. proposed a big data-driven mobile network optimization methodology. Recent work by Fadlullah et al. provides a comprehensive overview of deep learning's expansion across several fields, with particular focus on its potential use in traffic management networks. Their work also draws attention to various research questions that have yet to be answered.

Ahad et al. provide methods, programmes, and recommendations for implementing neural networks to solve issues in wireless networks. This article ignores the latest advances in deep learning and its successful implementations in contemporary mobile networks in favour of older neural network models, despite the fact that they have been shown to overcome the aforementioned limitations of neural networks. In this work, we explore the possibility for correct inference on mobile devices and the feasibility of using deep learning in mobile sensing. Recently, Ota et al. have reported new uses for deep learning in mobile multimedia. Their analysis includes cutting-edge applications of deep learning in areas such as mobile health and wellness, mobile security, mobile ambient intelligence, mobile language translation, and mobile voice recognition. Recently developed deep learning strategies for IoT data analysis are reviewed by Mohammadi et al. They provide a thorough review of the present initiatives that integrate deep learning into the IoT domain, illuminating the research problems that exist now and the potential avenues for future exploration. When it comes to wireless networking, Mao et al. zero in on deep learning. This study provides a comprehensive overview of current deep learning applications in wireless networks and identifies key areas of future research.

IoT fast and streaming data

Several studies have proposed using high-performance computing systems or the cloud to do streaming data analytics. Data parallelism and incremental processing provide the basis for streaming data analytics on such platforms. Parallel analytics may be executed in real-time on a big dataset by first dividing it into numerous smaller datasets using data parallelism. Incremental processing is the process of rapidly processing a subset of data in a pipeline of compute activities. Although these methods shorten the amount of time it takes for the streaming data analytic framework to provide a reply, they are not the ideal answer for time-sensitive IoT applications. Since the amount of the data in the source enables it to be processed swiftly, it is not necessary to employ data parallelism and incremental processing when streaming data analytics are performed closer to the source of data. Limitations in compute, storage, and power at the source of data are only a few of the difficulties that arise when attempting to do quick analytics on IoT devices.

DEEP LEARNING Architecture

Deep learning (DL) is a set of learning methods that use deep architectures to learn hierarchical representations, and may be either supervised or unsupervised. Deep learning architectures are often multi-layered. Every layer has the capability of producing non-linear responses depending on the information provided by the layer below it. DL's capabilities are modelled after the ways in which a human brain and neurons interpret messages. The field of DL architectures has been expanding at a faster rate than that of more conventional machine learning methods in recent years. Such methods are seen as simplified forms of DL that rely on shallow-structured learning architectures. While ANNs have been around for decades, the recent surge in popularity of DNNs may be traced back to 2006, when G. Hinton et al. proposed the idea of deep belief networks. Later, its cutting-edge functionality was noticed in several areas of artificial intelligence (AI), such as image recognition, image retrieval, search engines and information retrieval, and natural language processing.

On top of conventional ANNs, DL methods have been created. While Feed-forward Neural Networks (FNNs) (also known as Multilayer Perceptrons - MLPs) have been used to train systems for decades, their complexity increases dramatically as the number of layers grows. Another contributor to overfitted models is the limited size of the training set. Also, efficient deeper FNNs couldn't be implemented because to the limited processing power of the time. Recent developments in technology, especially Graphics Processing Units (GPUs) and hardware accelerators, have allowed us to overcome these computational barriers. Advances in effective training algorithms of deep networks have contributed to the success of DL approaches beyond the structural characteristics and relevance of depth of DL architectures and hardware breakthroughs.

Table 1 Summary of Deep Learning Models.

Model	Category	Learning model	Typical input data	Characteristics	Sample IoT Applications
AE	Generative	Unsupervised	Various	• Suitable for feature extraction, dimensionality reduction • Same number of input and output units • The output reconstructs input data • Works with unlabeled data	• Machinery fault diagnosis • Emotion recognition
RNN	Discriminative	Supervised	Serial, time-series	• Processes sequences of data through internal memory • Useful in IoT applications with time-dependent data	• Identify movement pattern • Behavior detection
RBM	Generative	Unsupervised, Supervised	Various	• Suitable for feature extraction, dimensionality reduction, and classification • Expensive training procedure	• Indoor localization • Energy consumption prediction
DBN	Generative	Unsupervised, Supervised	Various	• Suitable for hierarchical features discovery • Greedy training of the network layer by layer	• Fault detection classification • Security threat identification
LSTM	Discriminative	Supervised	Serial, time-series, long time dependent data	• Good performance with data of long time lag • Access to memory cell is protected by gates	• Human activity recognition • Mobility prediction
CNN	Discriminative	Supervised	2-D (image, sound, etc.)	• Convolution layers take biggest part of computations • Less connection compared to DNNs. • Needs a large training dataset for visual tasks.	• Plant disease detection • Traffic sign detection
VAE	Generative	Semi-supervised	Various	• A class of Auto-encoders • Suitable for scarcity of labeled data	• Intrusion detection • Failure detection
GAN	Hybrid	Semi-supervised	Various	• Suitable for noisy data • Composed of two networks: a generator and a discriminator	• Localization and wayfinding • Image to text
Ladder Net	Hybrid	Semi-supervised	Various	• Suitable for noisy data • Composed of three networks: two encoders and one decoder	• Face recognition • Authentication

One of the most important parts of a CNN is the convolution layer, which is made up of a collection of learnable parameters called filters that have the same form as the input but less dimensions. During training, the filter of each convolutional layer traverses the whole input volume and computes an inner product of the input and the filter. The filter's feature map is the result of this calculation performed across the whole input. Pooling layers, which function on the feature maps, are another component of a CNN. In order to lessen the likelihood of overfitting, minimise the number of parameters, and shorten computation times, pooling layers are used to shrink the size of the spatial representation. One typical method, called "max pooling," takes the input space, divides it into non-overlapping parts, and then selects the largest value for each region.

CHALLENGES AND PERSPECTIVES: DEEP LEARNING FOR BIG DATA

Recent years have seen Big Data emerge as a major topic of discussion in both government and the general public. To "help tackle some of the Nation's most urgent concerns," the Obama administration established the "Big Data Research and Development Initiative" in 2012. As a result, six federal departments and agencies have pledged over $200 million to fund initiatives that have the potential to revolutionise our capacity to draw unexpected insights from massive data sets. Massachusetts's Big Data Initiative, which provides grants to many different universities, was unveiled in May of the same year. In April of 2013, U.S. President Barack Obama announced a new federal project: the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) initiative, which aims to create new tools to better map human brain functions, understand the intricate relationships between brain function and behaviour, and ultimately find effective treatments for and cures for neurological disorders. According to NIH director Francis Collins, yottabytes (a billion petabytes) of data will need to be collected, stored, and processed as part of this initiative in the future, which could put a strain on existing technologies for Big Data collection and analysis.

It's true that Big Data has enormous promise, but realising that potential will need some fresh perspectives and innovative algorithms to overcome certain nagging technological hurdles. Most classic ML algorithms, for instance, were developed with the assumption that all data would fit entirely inside RAM. But now that we live in the era of Big Data, that simple premise no longer holds true. Therefore, we want algorithms capable of gaining insights from large datasets. Section 3 described recent success in large-scale deep learning, although the discipline is still in its infancy. The three V's model, which describes the huge size of data, the diverse kinds of data, and the pace of streaming data, respectively, all contribute to the many critical issues posed by Big Data.

Result and Discussion

Data analytics for big data has made great strides thanks to the use of deep learning algorithms, according to the available research. Problems in Big data analytics, such as large-scale data analysis, semantic indexing, data tagging, information retrieval, classification, and prediction, are significantly simplified by DL. However, deep learning has only made modest strides in areas such as model scaling, distributed computing, and high-scale data processing, as well as stream data and low-quality data processing. Several questions and directions for further study are outlined below.

1) As the amount of big data available to analyse grows, so does the need for more advanced, large-scale deep learning models. Depending on the methods and resources at hand, it may no longer be possible to effectively train such massive deep learning models that can be used for Big Data. Future work towards a solution will require the development of novel computational and learning infrastructures.

2) (2) Current multi-modal deep learning models do nothing more than add up the features learned for each modality in a linear fashion. Unfortunately, this rarely produces the desired outcomes. If we want to increase the efficiency of multi-modal deep learning models, we need to learn how to effectively fuse the features we've acquired. However, the high computational complexity of deep computational models is the result of the large number of parameters in these models. The computational complexity of deep computational models needs to be studied further.

3) Most parameter and structure-based integrated learning techniques are only useful for classic, hidden-layer learning models. The potential of integrated learning algorithms in deep learning models and deep architectures has to be explored.

4) Due to the imminent development of low-quality data, it is crucial to study trustworthy deep learning models for it.

Conclusion

In this work, we go into the application of deep learning to the challenge of analytics on Big Data. Deep Learning, unlike standard machine learning approaches, has the potential chances to solve many of the analytics and learning difficulties presented by Big Data analytics, as shown by a survey of relevant literature organised according to the use of Deep Learning in diverse areas. There are plenty of training objects available for deep learning thanks to Big Data, but there are also plenty of challenges, including issues with size, heterogeneity, noisy labelling, and non-stationary distribution. We need to tackle these technological hurdles with innovative approaches and game-changing solutions if we're going to fully tap into Big Data's promise. Because of this, future research into the topic of deep learning will need to be vast. To determine the many applications of Deep Learning in Big Data Analytics, this study presents a systematic review of relevant literature in Deep Learning research and its application to various domains. Since Deep Learning is still a young topic, there is a great need for further in-depth study. The areas of high dimensionality, streaming data analysis, scalability of Deep Learning models, improved formulation of data abstractions, distributed computing, semantic indexing, data tagging, information retrieval, criteria for extracting good data representations, and domain adaptation all need more research. The research corpus in Deep Learning and Big Data Analytics would benefit from future efforts that aim to solve one or more of these common Big Data issues.

References

1. Mehdi, Mohammadi., Ala, Al-Fuqaha., Sameh, Sorour., Mohsen, Guizani. (2018). Deep Learning for IoT Big Data and Streaming Analytics: A Survey. IEEE Communications Surveys and Tutorials, 20(4):2923-2960. doi: 10.1109/COMST.2018.2844341

2. Yaguo, Lei., Feng, Jia., Jing, Lin., Saibo, Xing., Steven, X., Ding. (2016). An Intelligent Fault Diagnosis Method Using Unsupervised Feature Learning Towards Mechanical Big Data. IEEE Transactions on Industrial Electronics, 63(5):3137-3147. doi: 10.1109/TIE.2016.2519325

3. Qingchen, Zhang., Qingchen, Zhang., Laurence, T., Yang., Laurence, T., Yang., Zhikui, Chen., Peng, Li. (2018). A survey on deep learning for big data. Information Fusion, 42:146-157. doi: 10.1016/J.INFFUS.2017.10.006

4. Charith, Perera., Chi, Harold, Liu., Srimal, Jayawardena., Min, Chen. (2014). A Survey on Internet of Things From Industrial Market Perspective. IEEE Access, 2:1660-1679. doi: 10.1109/ACCESS.2015.2389854

5. Zahangir, Alom., Tarek, M., Taha., Chris, Yakopcic., Stefan, Westberg., Paheding, Sidike., Mst, Shamima, Nasrin., Mahmudul, Hasan., Brian, Van, Essen., Abdul, A., S., Awwal., Vijayan, K., Asari. (2019). A State-of-the-Art Survey on Deep Learning Theory and Architectures. Electronics, 8(3):292-. doi: 10.3390/ELECTRONICS8030292