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Cloud Powered Deep Learning-Emerging Trends

Srinivas Jagirdar[1*], K.Venkata Subba Reddy[2], Dr.Ahmed Abdul Moiz Qyser[3]

[1,2,3]Department of Computer Science and Engineering,
Muffakham Jah College of Engineering & Technology, Hyderabad

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***Abstract*—**Cloud Computing is making inroads into other areas of research. Advanced research area like Deep Learning is now not limited to just huge organizations. Cloud Computing is making it easy for even small researchers to have a go at Deep Learning. One needs to just harness the unlimited Computing power the Cloud offers. This paper presents a review of Deep Learning, opportunities & Challenges of Deep Learning .The paper also throws light on the role of Cloud Computing in Deep Learning.

Keywords—Deep Learning, Machine Learning, Cloud Computing, Deep Clouds

I. INTRODUCTION

Deep learning is an up-and-coming research area in machine learning and pattern recognition field. Deep learning refers to machine learning techniques that use supervised or unsupervised strategies to robotically be trained the hierarchical representations in deep architectures for classification. The purpose is to understand more abstract features in the superior levels of the depiction, by using neural networks which easily break up an assortment of instructive factors in the data. In the recent years it has attracted much interest due to its high-tech performance in diverse areas like object perception, speech recognition, computer vision, collaborative filtering and natural language processing [1],[2],[3],[4].As the data keeps getting superior, deep learning is coming to play a vital role in providing big data predictive analytics solutions.

"Deep learning refers to a class of machine learning techniques, where many layers of information processing stages in hierarchical architectures are exploited for pattern classification and for feature or representation learning" [5]. It is in the fork among the research areas of neural network, graphical modeling, optimization, pattern recognition, and signal processing. Apart from the radical increase in chip processing abilities (e.g., GPU units), lowered cost of computing hardware and advances in machine learning research, the implementation of Cloud based computing has accelerated the progress made in Deep Learning. Vigorous researchers in this field comprise those at IBM Research, Facebook, Google, Baidu, New York University, University of Montreal, Microsoft Research, University of Michigan, MIT, University of Washington, Stanford University, University of Toronto and numerous other places. Mark off, 2012 reported that Deep Learning techniques for analyzing molecules which can be used in preparation of new drugs. Deng et al review shows that deep learning systems have radically improved the precision of speech recognition and a variety of deep architectures and learning techniques have been developed with discrete strengths and weaknesses in latest years [6].

NIST defines Cloud computing "as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimalmanagement effort or service provider interaction". This cloud model endorses availability and is poised of five vital characteristics namely On-demand self-service, broad network access, Resource pooling, Rapid elasticity and Measured Service[7].The model also encompasses three service models viz. Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS) and Cloud Infrastructure as a Service (IaaS). It also has four exploitation models viz. Private cloud, Community cloud, Public cloud and the Hybrid cloud. Fast wide-area networks, powerful, inexpensive server computers, and high-performance virtualization for commodity hardware are the factors that determine the Success of Cloud Computing. Cloud computing has surfaced as a trendy solution to provide economical and easy admission to externalizedInformation Technology resources [8]. Fig.1 represents a Conceptual Reference Architecture of a Cloud Computing Environment [9-15].

The rest of the paper is organized as follows. Section-II explains a Deep Learning Work Flow. Section-III gives an overview of Deep Learning Architectures. Section-IV depictsthe role of Cloud Computing in accelerating the research pertaining to Deep Learning. Section-V describes the applications and challenges of Deep Learning. Section-VI draws conclusions.

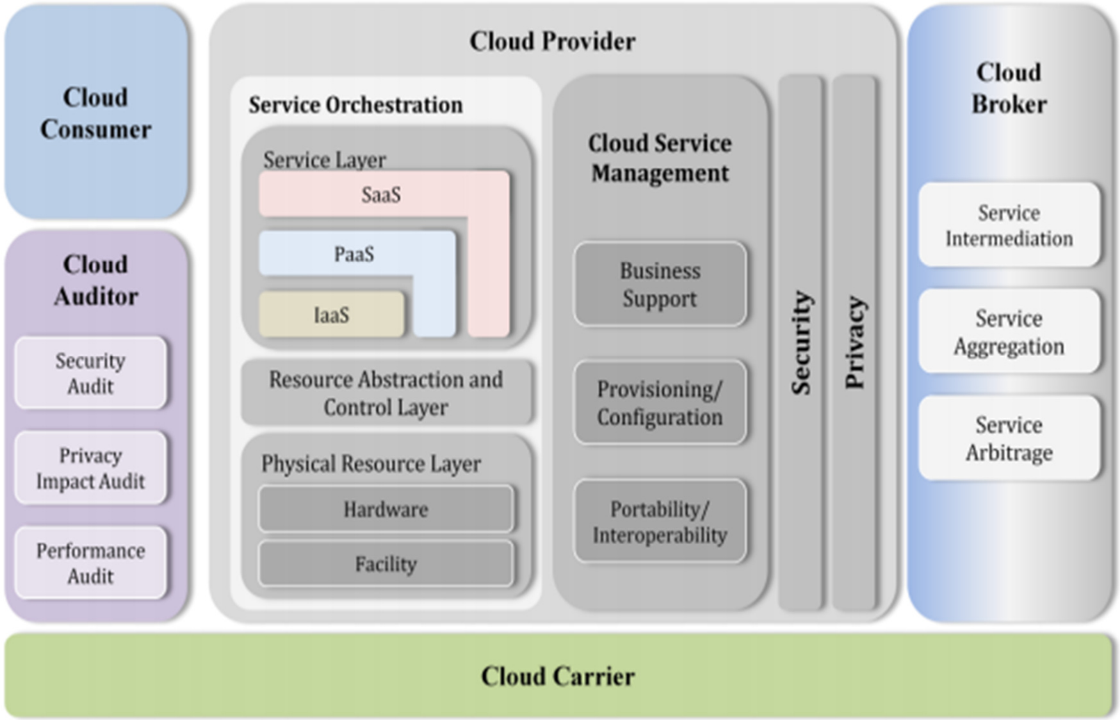

Fig.1 Conceptual Reference Model (Source: NIST)

II. WORK FLOW

In this section a Deep Learning Work Flow is presented.
The steps are as follows

1. Collect Labeled data.
2. 80% used for Training set.
3. 20% used for validation set.
4. Study the Deep Neural Network
5. The next step is to validate.
6. If validated stop else adjust the hyper parameters and Neural Network model.

III. CLASSES OF DEEP ARCHITECTURES: A GENERAL IDEA

As portrayed previously, deep learning refers to a slightly broad class of machine learning techniques and architectures, with the characteristic of using many layers of non-linear information processing phases that are hierarchical in nature. Depending on how the architectures and methods are intended for use, e.g., synthesis/generationor recognition/classification, one can broadly catalog most of the work in this region into three major classes:

A. Generative Deep Architectures

These architectures are planned to distinguish the high-order association properties of the experimental or visible data for pattern scrutiny or synthesis purposes, and/or illustrate the joint statistical distributions of the observable data and their linked classes. In the second case, the application of Bayes rule can twist this type of architecture into a discriminative one. Table-1 lists the various Generative deep architectures available in the Literature.

S.No	Deep network model for unsupervised or generative learning	Literature
1.	The energy-based deep models	Bengio at al., 2006; lecun et al., 2007; Ngiam et al., 2011; Bengio, 2009)
2.	Transforming auto encoders	Hinton et al., 2011
3.	Predictive sparse coders and their stacked version	Vincent et al., 2010
4.	De-noising auto encoders and their stacked versions	Vincent et al., 2010
5.	Deep Boltzmann machine or DBM	Salakhutdinov and Hinton, 2009, 2012; Srivastava and Salakhutdinov, 2012; Goodfellow et al., 2013
6.	Sum-product network or SPN	Poon and Domingo, 2011; Gens and Domingo, 2012
7.	Recurrent neural networks	Bengio et al., 2013a; Pascanu et al., 2013; Chen and Deng, 2013
8.	Dynamic or temporally recursive generative models	Taylor et al., 2007

Table 1: Generative Deep Architectures

B. Discriminative Deep Architectures

These architectures are planned to openly provide discriminative authority for pattern classification, frequently by characterizing the posterior distributions of classes trained on the perceptible data. Table-2 lists the various Discriminative deep architectures available in the Literature.

S.No	Deep Network Model	Literature
1.	HMM	Juang et al., 1997; Chengalvarayan and Deng, 1998; Povey and Woodland, 2002; Yu et al., 2007; He et al., 2008; Jiang and Li, 2010; Xiao and Deng, 2010; Gibson and Hain, 2010
2.	Conditional Random Fields (CRFs)	Yang and Furui, 2009; Yu et al., 2010; Hifny and Renals, 2009; Heintz et al., 2009; Zweig and Nguyen, 2009; Peng et al., 2009
3.	MLP architecture using back propagation learning with random initialization	Morgan et al., 2005
4.	Deep Stacking Network DSN	Deng et. al, 2011; Deng et al., 2012a; Tur et al., 2012; Lena et al., 2012; Vinyals et al., 2012
5.	Convolutional Neural Network (CNN)	Bengio and LeCun, 1995; LeCun et al., 1998; Ciresan et al., 2010, 2011, 2012, 2012a; Le et al., 2012; Dean et al., 2012; Krizhevsky et al., 2012, Zeiler, 2014
6.	Time-delay Neural Network TDNN	Lang et al., 1990; Waibel et al., 1989
7.	Hierarchical temporal memory	Hawkins and Blakeslee, 2004; Hawkins et al., 2010; George, 2008
8.	Architecture developed for bottom-up, detection-based speech recognition	Lee, 2004

Table 2: Discriminative deep architectures

C. Hybrid Deep Architectures

These architectures are where the objective is discrimination but is supported (often in a significant way) with the results of generative architectures via enhanced optimization or/and regularization, or when discriminative criteria are used to learn the constraints in any of the deep generative models in class 1) described above. Table-3 lists the various Hybrid deep architectures available in the Literature.

S.No	Deep Network Model	Literature
1.	DNN-CRF	Mohamed et al., 2010
2.	DEEP CNNS	Lee et al., 2009, 2010, 2011
3.	Speech translation (two-stage deep architecture)	Ney, 1999; He and Deng, 2011
4.	Speech information retrieval	Yamin et al., 2008
5.	Speech understanding	Tur et al., 2012
6.	Cross-lingual speech/text understanding and retrieval	He and deng, 2012, 2013; deng et al., 2012; deng et al., 2013a; he et al., 2013

Table 3: Hybrid Deep Architectures

IV. ROLE OF CLOUD IN DEEP LEARNING

In this section of the paper discusses the role of Cloud in Deep Learning. In the latter half of the section examples of Clouds dedicated to Deep Learning are elaborated. Progress in deep learning and artificial intelligence are hastening because colossal computing power is finally reachable to companies of every size. Cloud computing is attesting itself as a factual game-changer in this "futuristic" zone because it manages to pay for a variety of vital resources. Although researched in academia for decades, Machine Learning is progressively moving into business computing use, credit to both the proliferation of low-priced cloud computing and gigantic amounts of data. Slackly based on how the brain processes information, Machine Learning moves away from basic computational data scrutiny in that it provides the skeleton for a computer to make speculations about what will ensue in the future, given a set of data. The prediction process is polished through response loops, or neural nets, allowing the algorithm to filter itself with recurring iterations of testing. Fig.2 represents a basic Cloud Computing environment. The Cloud based Deep Learning is being implemented by companies of all sizes. A glimpse of such Clouds is described in this section of the paper.

Fig. 2A Cloud Computing Environment [8]

Table- 4 lists the Clouds that are involved in Deep Learning.

S.No	Name of Cloud	Service Provider
1.	Nervana	Nervana
2.	Cloud Machine Learning- Tensor Flow	Google
3.	ML service on Azure	Microsoft
4.	Watson Analytics	IBM
5.	MetaMind	MetaMind

Table 4: .A list of Clouds dedicated for Deep Learning

An introduce "Nervana cloud" is a hosted platform intended to furnish companies of all dimensions the capability to swiftly assemble and deploy deep-learning tools without having to spend in infrastructure equipment or an outsized team of professionals. Nervana is an open-source deep-learning framework; the full-stack offering is optimized to hold multifarious machine-learning problems at scale. It is based on Neon.

Google Cloud Machine Learning, a scaffold for building and training routine models to be used in intelligent applications. Google open sourced its second generation artificial intelligence engine, Tensor Flow to accelerate user-friendly machine learning (ML). It aims to maintain the full range and offer a seamless shift from local to cloud environment.

Microsoft recommends a ML service on its Azure cloud computing service and is nurturing a community where data scientist can distribute and acquire algorithms on everything from tone detection to highlighting groups of products that have been procured concurrently.

IBM launched an open beta of Watson Analytics, a cloud platform for data exploration, visualization and predictive analytics. Watson is targeted more towards placing fundamental analytical tools in the dispense of everyone than towards offering large-scale cloud-based machine learning for ventures.

MetaMind spotlights on deep learning, a mushrooming new field that leverages the power of GPUs, distributed systems and new training techniques to construct many-layered artificial neural networks which have recently set records on tasks in speech recognition and computer vision. MetaMind is focused on the state of the art, taking a technology that is presently only in the grip of a tiny number of enterprises and making it accessible to a wider array of companies and developers.

V. APPLICATIONS AND CHALLENGES OF DEEP LEARNING

Cloud powered Deep learning Techniques are finding their place in numerous advanced fields. Here is a compact list of Application areas of Deep Learning Techniques:

1. Face Detection.
2. Speech recognition & Detection.
3. General object Recognition.
4. Computer Vision.
5. Pattern Recognition.
6. Big Data Analytics.
7. Robotics.
8. Information Retrieval..
9. Natural Language Processing.
10. Molecule Analysis.

The challenges that Cloud Computing is solving for Deep Learning are as follows-

A. Scaling neural networks for deep learning has been a noteworthy contribution.Managing the degree of traffic that occurs in outsized deep-learning networks throughout the update

B. Providing architecture for shoving the Neural Network applications out to hundreds of thousands of servers, and reaping the results.

The challenges like improving supervised deep learning, exploiting distant supervision signals and flat dense-vector embedding are still areas of future research interests.

VI. CONCLUSIONS

This paper presents acritical overview of Deep Learning, its architectures applications and Challenges. It also provides the importance of Cloud Computing in Deep Learning. The paper also discusses some of the existing clouds that are influencing Deep Learning Research. Cloud powered Deep Learning is promising to be a new research area in the field of Computers.

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REFERENCES

[1] G Hinton, S Osindero and Y The “A fast learning algorithm for deep belief nets”, Neural Computation, vol. 18, pp. 1527-1554, 2006.

[2] Y Bengio “Learning deep architectures for AI”, Foundations and Trends in Machine Learning, Vol. 2, No. 1, 2009, pp. 1-127.

[3] Y Bengio, N Boulanger, and R Pascanu. “Advances in optimizing recurrent networks,” Proc. ICASSP, 2013.

[4] Y Bengio, A Courville and P Vincent,“Representation learning: A review and new perspectives,” IEEE Trans. PAMI, 2013.

[5] Li Deng, “A Tutorial Survey of Architectures, Algorithms, and Applications for Deep Learning” ,APSIPA-Transactions on Signal and Information Processing, 2012.

[6] L Deng, D Yu and J Platt “Scalable stacking and learning for building deep architectures”, Proc. of International Conference on Acoustics, Speech and Signal Processing , 2012.

[7] Peter Mell and Timothy Grance, “The NIST Definition of Cloud Computing”, SP 800-145, September 2011.

[8] J. Srinivas, K. Venkata Subba Reddy and Dr. A. A. Moiz Qyser, “Cloud Computing Basics” ,International Journal of Advanced Research in Computer and Communication Research, ISSN: 2278-1021, pp 343-347, Vol 1, Issue 5, July 2012.

[9] Fang Liu, Jin Tong, Jian Mao, Robert Bohn, John Messina, Lee Badger and Dawn Leaf “NIST Cloud Computing Reference Architecture”, Special Publication 500-292.

[10] Y Bengio, “Learning deep architectures for AI,” in Foundations and Trends in Machine Learning, Vol. 2, No. 1, pp. 1- 127, 2009.
[11] Li Deng, Xiaodong He, JianfengGao, “Deep stacking networks for information retrieval”, IEEE International conference on Acoustics speech and signal processing, 2013.
[12] Zachary Chase Lipton, “Cloud Machine Learning Wars: Amazon vs IBM Watson Vs Microsoft Azure”, UC SD.
[13] George Lawton,“Google Brings Deep Learning to the Cloud”, IEEE INTELLIGENT SYSTEMS September/October 2012 .
[14] B.Kwolek, “Face detection using convolution neural networks and Gabor filters”, in Lecture Notes in Computer Science, vol. 3696. 2005, p. 551

AUTHOR PROFILE

Mr.J.Srinivas obtained his Bachelor's degree in computers science & Information Technology from JNTU, Hyderabad in 2005 and received the Masters Degree in Software Engineering from JNTUH, in 2010. His research interests include Cloud Computing, Software Engineering, Web Technologies and Data mining. Currently he is pursuing his Ph.D. in CSE at JNTUA, Ananthapuramu.

Mr..K.Venkata Subba Reddy obtained B.Tech in Information Technology from University of Madras in 2002, M.Tech in Software Engineering from Bharath Institute of Higher Education and Research, Chennai in 2005, He is currently pursuing Ph.D.,in Computer Science and Engineering, at Acharya Nagarjuna University, Guntur, Andhra Pradesh, India. His research interests include Software Engineering, Cloud computing. He is a life member of ISTE and a member of CSI.

Dr. Ahmed Abdul Moiz Qyser received his B.E. (CSE) from Osmania University, M.Tech. (Software Engineering) from JNTU, Hyderabad, and Ph.D from Osmania University. His research focus is Software Process Models and Metrics for SMEs. He is presently working as Professor and Head in Department of CSE, at Muffakham Jah College of Engineering and Technology, Hyderabad, India. He is also a visiting Professor to the industry where he teaches Software Engineering and its related areas. He is the author of several research papers in the area of Software Engineering. He is an active member of ACM, CSI and ISTE.

