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COMPARATIVE ANALYSIS OF ALGORITHMS USED IN DEEP LEARNING

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Abstract: The paper reviews the work done in deep learning. Deep Learning is an emerging field as it is used in many areas such as banking, retail, online shopping and so on. Hence the review mainly focuses on the application and usage of the algorithms this paper forms the overview of research done in deep learning for the last few years.
Keywords: Deep Learning, Convolutional neural network(CNN), Artificial intelligence(AI)

1. Introduction

As the world is automating, artificial intelligence comes into the light, as AI is a broad spectrum and the research is still penetrating the field. Machine learning, deep learning are the few subsets of it that are still under the research field. Deep learning is the class of machine learning algorithms that uses multiple layers to extract higher-level features from the raw input. Most deep learning models are based on artificial neural networks (ANN), specifically convolutional neural networks, they also include propositional formulas or latent variables organized layer-vise in deep generative models such as the nodes in deep belief networks and deep Boltzmann machines. In Deep Learning, every level learns to transform its input data into a slightly more abstract and composite representation. The word deep in deep learning refers to the number of layers through which the data is transformed it can be compared with the credit assignment path (CAP) depth. CAP is the chain of transformations from input to output which can be used in the feedforward neural network. For a recurrent neural network, the signal may propagate through a layer or more than once. Most researchers agree that deep learning involves CAP depth higher than 2, for supervised learning tasks, deep learning methods eliminate the feature engineering by translating the data into compact intermediate representations to principal components to remove redundancy in representation.

Deep Learning has numerous applications in various fields which include automobiles, banking, robotics, entertainment, Medical, and health care. The usage of algorithms is different in different fields so its importnant for an enthusiast to know the importance of every algorithm and how it helps with the result. The artificial neural networks (ANNs) are the computing systems inspired by the biological neural network that constitute animal brains and to do the task that a human can do normally. The neurons actually map on to the human brains which have several neurons connected and the information is transmitted, it can be used on a variety of tasks, including computer vision, speech recognition, image recognition, machine translation, social network filtering, playing board and video games and medical diagnosis.

Deep neural network(DNN) is an artificial neural network with multiple layers between the input and output it uses the correct mathematical manipulation to turn into the output it goes through the layers and

calculate the probability of the output. Each mathematical manipulation as such is considered a layer, and complex DNN has many layers, hence deep networks, DNN creates a map of virtual neurons and assigns random weights to connect between them, these weights are then multiplied and return an output between 0 and 1. If the network did not accurately recognize the particular pattern, an algorithm would tweak the weights, until it determines the correct mathematical manipulation to fully process the data.

The algorithms of deep learning:-

- Convolutional neural network(CNNs)
- Recurrent Neural Network(RNNs)
- Long Short-Term Memory Networks(LSTMs)
- Auto-Encounters
- Boltzmann Machine

2. Literature Review

This section reviews papers based on deep learning algorithms used in various fields. Papers published in the last ten years is reviewed and analyzed based on the algorithms used.

Yan Zhang in Speech recognition using deep learning[1] discusses how conventional methods of speech recognition using a Gaussian mixture model(GMM) based hidden Markov model(HMM) are statistically inefficient for modeling data that lie on or near non-linear manifold of data space and deep learning algorithms like the deep neural network and deep belief network have been used and a DBN has been implemented for automatic speech recognition, the speech recognition performance of GMM-HMM, DNN-HMM and DBN have been performed with TIMIT acoustic-phonetic continuous speech corpus dataset in terms of word error rate. The results have shown that the DBN based speech recognition system is better than the other two.

Feature Extraction In Medical Images by Using Deep Learning Approach by Suresh Dara and Priyanka Tumma, Nageswara Rao Eluri, Gangadhara Rao Kancharla,[2] discuss the feature extraction and how it can be used for converting training data and establish it with extra features to make machine learning algorithms much adequate. The paper presented a technique for finding the impact of automatic feature extraction and distribution that uses CNN, a path suggested consistently to consider the classification efficiency of CNN, image, and feature-based traditional MLPs. CNN with automatic feature extraction was first classified on a well- established to a traditional MLP with full image and standard feature extraction were evaluated with proposed results presented in the form of classification accuracy

In *Image Classification using Convolutional Neural Networks paper by Muthukrishnan Ramprasath, M.Vijay Anand, Shanmugasundaram Hariharan* [3] handwritten MNIST data sets were used. These data sets used both and training and testing purposes using CNN providing an accuracy rate of 98%. Images used in the training purpose are small and Grayscale images. Stacking the model with more layers and training the network with more image data using clusters of GPUs will provide more accurate results of the classification of images. The layers used in CNN is proportional to the accuracy and the loss of the trained model. The epochs can be increased and the accuracy can be achieved, increasing the time to train the model. The loss reduces with the increasing accuracy in every epoch. The loss function can be used from Regression Loss Functions, Binary Classification Loss Functions, Multi-Class Classification Loss Functions according to the requirement. The image pixels and size matters when training the model and can choose if the images should be in grayscale or color.

[10]*The Applications of Deep Learning on Traffic Identification Zhanyi Wang* shows how it's difficult for traffic identification and to find features in the flow data the process is very time- consuming. Also, these approaches are invalid to unknown protocols. To solve these problems a method is proposed in this paper that is based on neural network and deep learning. The dataset used is TCP flow data from the internal network and joint the payload bytes for every TCP session, where a byte is represented by an integer from 0 to 255. Then it is normalized on the scale to [0, 1], the length of each payload sequence is 1,000 about 0.3 million records are picked up after wiping off duplications for experiments. The number of protocol types in the data is 58. Because HTTP is apt to identify, this type of data that accounts for 80% is excluded. Flow data is very similar to the examples of PR. It can be imaged that a payload record is a picture or a document, and each byte is a pixel or a word. Since pictures and documents can be learned feature and classified very well by deep learning, it's reasonable to expect good performance in information security. This paper solves the problem of non-automation and poor adaptation in traditional ways

In the paper [12] *Improving Deep Learning Performance Using Random Forest HTM Cortical Learning Algorithm Mohamed Abdelhamid Abbas, Ph.D.* feature has proposed an algorithm called RFHTMC which is then merged versions from the random forest and HTM Cortical Learning Algorithm. Testing of the data sets is tested first then the prediction process is started including the calculation of the mean absolute percentage error for all the nodes. The going through towards the active nodes. The fitting model during the prediction process is applied via the HTM algorithm by dividing each active oath as sub active segments. a comparison is held between RFHTMC and HTM through two case studies. The use of deep learning and machine learning systems depends on their behavior and performance. The main objective of this paper was to improve the performance of this type using the combined version from the random forest and HTM Cortical Learning Algorithm. The proposed algorithm is called RFHTMC. The results depict that the proposed algorithm can reduce the mean absolute percentage error by half and increases the overlap duty cycle by 15%.

[20] *Development and Validation of Deep Learning Algorithms for Detection of Critical Findings in Head CT Scans Sasank Chilamkurthy, Rohit Ghosh, Swetha Tanamala, Mustafa Biviji, Norbert G. Campeau, Vasantha Kumar Venugopal, Vidur Mahajan, Pooja Rao, and Prashant Warier* shows the deep learning application in head CT scans with data sets of 313,318 anonymous head CT scans from several centers in India *Training* this model requires a large amount of data for which the ground truth is already known. Training is usually performed by an algorithm called backpropagation. In this algorithm, the model is iteratively modified to minimize the error between predictions of the model and the known ground truth for each data point the results show that deep learning algorithms can be trained to detect critical findings from head CT scans with good accuracy. The strong performance of deep learning algorithms suggests they could be a helpful adjunct for the identification of acute Head CT finding in a trauma setting, providing a lower performance bound for quality and consistency of radiologic interpretation. It could also be feasible to automate the triage process of Head CT scans with these algorithms. However, further research is necessary to determine if these algorithms enhance the radiologists' efficiency and ultimately improve patient care and outcome.

Training deep learning-based image denoisers from undersampled measurements without ground truth and image prior Magauiya Zhussip, Shakarim Soltanayev, Se Young Chun [28] proposes methods for unsupervised training of image denoisers with undersampled CS measurements. Their methods simultaneously performed CS image recovery and DNN denoiser learning. Their proposed method yielded better image quality than conventional methods at higher sampling rates for I .i.d Gaussian, CDP, and CS MR measurements. Thus, it may be possible that this work can be helpful for areas where obtaining ground truth images is challenging such as hyperspectral or medical imaging. They compared their proposed LDAMP SURE with state-of-the-art CS method that does not require ground data

Learning Deep Architectures for AI Yoshua Bengio [39] This paper started with several motivations: first to use learning to approach AI, then on the intuitive plausibility of decomposing a problem into multiple levels of computation and representation, followed by theoretical results showing that a computational architecture that does not have enough of these levels can require a huge number of computational elements, and a learning algorithm that relies only on local generalization is unlikely to generalize well when trying to learn highly-varying functions The discussion focused on the difficulty of optimizing deep architectures for learning multiple levels of distributed representations. Although the reasons for the failure of standard gradient-based methods, in this case, remain to be clarified, several algorithms have been introduced in recent years that demonstrate much better performance than was previously possible with simple gradient-based optimization, and we have tried to focus on the underlying principles behind their success.

3. Methodologies

Various algorithms are used in reviewed papers. Along with various pre-processing that is used for any deep learning models the application and the usage of different algorithms in the reviewed papers can be used as future studies. Before using any data, data pre-processing should be done.

3.1 Pre-processing

Pre-processing is the most important part of any deep learning model. Well, processed determines the accuracy and efficiency of the model. When training a neural network one must keep in mind that the quality of the training data determines the quality of your model. The data will contain non-uniform data formats, missing values, outliers and features with very different ranges Pre-processing techniques used in papers reviewed are discussed below

1. **Normalization**: Normalization simply scales the value in the range[0-1]. To apply it on a dataset you just have to subtract the minimum value from each feature and divide it with the range (max-min)
2. **Standardization:** Standardization transforms data to have zero mean and one unit standard deviation
3. **Implementation:** Implementing the techniques

The above where for the numerical data often what we need to handle is categorical data and they cant be fed to a neural network in their format

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1. **Indexing**: Indexing is simply replacing a category name with an index or a number
2. **OneHotEncoding**: OneHotEncoding is replacing each element by a list of boolean values with 1 in the present category index and 0 in the others
3. **Reshaping**: Reshaping is usually done for the image dataset for image manipulation and is usually used with NumPy

3.2 Algorithms

Convolutional neural network(CNNs):- A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm that can take in an input image, assign importance to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets can learn these filters/characteristics.

Recurrent Neural Network (RNN):- Recurrent Neural Network remembers the past and it's decisions are influenced by what it has learned from the past. Note: Basic feedforward networks "remember" things too, but they remember things they learned during training. For example, an image classifier learns what a "1" looks like during training and then uses that knowledge to classify things in production.

Long Short-Term Memory Networks(LSTM):- An LSTM has a similar control flow as a recurrent neural network. It processes data passing on information as it propagates forward. The differences are the operations within the LSTM's cells. These operations ar.e used to allow the LSTM to keep or forget information. Now looking at these operations can get a little overwhelming so we'll go over this step by step.

Auto-Encoders:- Autoencoder is an unsupervised artificial neural network that learns how to efficiently compress and encode data then learns how to reconstruct the data back from the reduced encoded representation to a representation that is as close to the original input as possible. Auto-encoder, by design, reduces data dimensions by learning how to ignore the noise in the data.

Boltzmann Machine:- Boltzmann machines are stochastic and generative neural networks capable of learning internal representations and can represent and solve difficult combinatoric problems. They are named after the Boltzmann distribution which is an integral part of Statistical Mechanics and helps us to understand the impact of parameters like Entropy and Temperature on the Quantum States in Thermodynamics

3.3 Performance Measures:

1. Accuracy: It is the ratio of the number of correct predictions to the total number of input samples.
2. Error rate: The inaccuracy of predicted output values of categorical target values.
3. Precision: It refers to the fraction of relevant instances among the total retrieved instances.

4. Conclusion

Deep learning is an emerging field and it needs a detailed study of its every algorithm This paper showed an overview of various deep learning techniques used for various usage. Regarding the algorithms, each algorithm is used in many ways and different use cases. Another important point to consider is the usage of algorithms that provide significant improvement in performance. This paper also summaries various methodologies used in modeling.

References

[1]. [1] Speech Recognition Using Deep Learning Algorithms — Zhang, SUNet ID: yzhang5 Instructor: Andrew Ng.
[2]. Feature Extraction In Medical Images by Using Deep Learning Approach — Suresh Dara and Priyanka Tumma, Nageswara Rao Eluri, Gangadhara Rao Kancharla
[3]. Image Classification using Convolutional Neural Networks — Muthukrishnan Ramprasath, M.Vijay Anand, Shanmugasundaram Hariharan
[4]. Real-Time Document Image Classification using Deep CNN and Extreme Learning Machines— Andreas Ko¨lsch , Muhammad Zeshan Afzal , Markus Ebbecke , Marcus Liwicki.
[5]. Efficient Processing of Deep Neural Networks: A Tutorial and Survey—- By ViVienne Sze Yu-HSin CHen , Tien-Ju Yang , Joel S. emer
[6]. Predicting Survival of Brain Tumor Patients using Deep Learning —- Sharmila Agnal A, Arun Deepak C, Venkatesh J, Sudarshan S, Pranav A

[7]. A Survey of Deep Neural Network Architectures and Their Applications — Weibo Liu, Zidong Wang, Xiaohui Liu, Nianyin Zeng, Yurong Liu and Fuad E. Alsaadi
[8]. A study on Deep Machine Learning Algorithms for diagnosis of diseases — Dinu A.J, Ganesan R, Felix Joseph and Balaji V
[9]. Comparative Performance of Deep Learning and Machine Learning Algorithms on Imbalanced Handwritten Data (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 9, No. 2, 2018 —A‟inur A‟fifah Amri, Amelia Ritahani Ismail, Abdullah Ahmad Zarir
[10]. The Applications of Deep Learning on Traffic Identification — Zhanyi Wang
[11]. Fruit recognition from images using deep learning — Horea MURESAN , Mihai OLTEAN.
[12]. Improving Deep Learning Performance Using Random Forest HTM Cortical Learning Algorithm Mohamed AbdElhamid Abbas , PhD
[13]. Deep Neural Networks for Object Detection Christian Szegedy Alexander Toshev Dumitru Erhan
[14]. A Deep Learning Approach to Network Intrusion Detection Nathan Shone , Tran Nguyen Ngoc, Vu Dinh Phai , and Qi Shi
[15]. On the Effectiveness of Machine and Deep Learning for Cyber Security — Giovanni Apruzzese , Michele Colajanni , Luca Ferretti , Alessandro Guido , Mirco Marchetti
[16]. Deep Convolutional Neural Networks (CNN) for Medical Image Analysis by N. Deepa, SP. Chokkalingam
[17]. Deep Learning for Natural Language Processing Tianchuan Du , Vijay K. Shanker
[18]. A fast learning algorithm for deep belief nets — Geoffrey E. Hinton, Simon Osindero and Yee-Whye Teh
[19]. Comparative Performance of Deep Learning and Machine Learning Algorithms on Imbalanced Handwritten Data (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 9, No. 2, 2018 —A‟inur A‟fifah Amri, Amelia Ritahani Ismail, Abdullah Ahmad Zarir
[20]. Development and Validation of Deep Learning Algorithms for Detection of Critical Findings in Head CT Scans Sasank Chilamkurthy, Rohit Ghosh, Swetha Tanamala, Mustafa Biviji, Norbert G.Campeau, Vasantha Kumar Venugopal, Vidur Mahajan, Pooja Rao, and Prashant Warier
[21]. Learning Transportation Modes from Smartphone Sensors Based on Deep Neural Network Shih-Hau Fang, Senior Member, IEEE, Yu-Xaing Fei Zhezhuang Xu, and Yu Tsao, Member, IEEE
[22]. DeepPose: Human Pose Estimation via Deep Neural Networks Alexander Toshev Christian Szegedy
[23]. Deep Learning for Remote Sensing Data LIANGPEI ZHANG, LEFEI ZHANG, AND BO dU
[24]. Parkinson's Disease Detection And Classification Using Machine Learning And Deep Learning Algorithms– A Survey Muthumanickam S , Gayathri J , Eunice Daphne J
[25]. Deep Learning for Semantic Segmentation of Coral Reef Images Using Multi-View Information Andrew King Suchendra M. Bhandarkar Brian M. Hopkinson
[26]. LCNN: Lookup-based Convolutional Neural Network Hessam Bagherinezhad, Mohammad Rastegari, Ali Farhadi
[27]. Survey of Deep Learning Applications to Medical Image Analysis Kenji SUZUKI
[28]. Training deep learning based image denoisers from under sampled measurements without ground truth and without image prior Magauiya Zhussip, Shakarim Soltanayev, Se Young Chun
[29]. Diagnostic Assessment of Deep Learning Algorithms for Detection of Lymph Node Metastases in Women With Breast Cancer Babak Ehteshami Bejnordi, MS; Mitko Veta, PhD; Paul Johannes van Diest, MD, PhD; Bram van Ginneken, PhD; Nico Karssemeijer, PhD; Geert Litjens, PhD; Jeroen A. W. M. van der Laak, PhD; and the CAMELYON16 Consortium
[30]. End-to-End Multimodal Emotion Recognition Using Deep Neural Networks Panagiotis Tzirakis , George Trigeorgis , Mihalis A. Nicolaou, Member, IEEE, Bjo¨rn W. Schuller, and Stefanos Zafeiriou
[31]. Deep Learning Earth Observation Classification Using ImageNet Pretrained Networks Dimitrios Marmanis, Mihai Datcu, Fellow, IEEE, Thomas Esch, and Uwe Stilla, Senior Member, IEEE
[32]. Deep learning applications and challenges in big data analytics Maryam M Najafabadi, Flavio Villanustre , Taghi M Khoshgoftaar , Naeem Seliya , Randall Wald and Edin Muharemagic
[33]. Deep Learning for Classification of Hyperspectral Data: A Comparative Review Nicolas Audebert, Bertrand Saux, Sébastien Lefèvre
[34]. This paper DL4MD: A Deep Learning Framework for Intelligent Malware Detection William Hardy, Lingwei Chen, Shifu Hou, Yanfang Ye, and Xin Li

[35]. DLAU: A Scalable Deep Learning Accelerator Unit on FPGA Chao Wang, Member, IEEE, Lei Gong, Qi Yu, Xi Li, Member, IEEE, Yuan Xie, Fellow, IEEE, and Xuehai Zhou, Member, IEEE
[36]. Handwritten Digit Recognition Using Deep Learning Anuj Dutt, AashiDutt
[37]. Deep Learning for Imbalanced Multimedia Data Classification Yilin Yan , Min Chen , Mei-Ling Shyu, and Shu-Ching Chen
[38]. THE CONVERGENCE OF MACHINE LEARNING AND COMMUNICATIONS Wojciech Samek, Slawomir Stanczak, Thomas Wiegand
[39]. Learning Deep Architectures for AI Yoshua Bengio

