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A Survey on Deep Learning Representations

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***Abstract*—Imitating the efficiency and robustness of human brain has always been a core challenge in the research of artificial intelligence. Deep Learning, a new area of Machine Learning, has been coined with the aim of moving Machine Learning closer to Artificial Intelligence. Machine learning a branch of science that deals with programming the systems in such a way that they automatically learn and improve with experience. Deep learning comprehends the inner structure of observed data and Cross-linking new and known concepts to make nonobvious inferences. This paper emphasis on better understanding of Deep Learning Concepts and Architecture models. This paper also gives an idea of applications contributing to research in the area of deep learning.**

***Index Terms*— Biometric recognition, Machine Learning, Deep representation, Spoofing detection.**

I. INTRODUCTION

Neural Networks is a biologically-inspired programming paradigm which enables a machine to gain input from observational data and provides valuable information. First and foremost a model from their training data or input data is designed. One best example of neural network is the recognition of handwritten digits using training datasets and then develops a system which can learn from those training examples. In other words, the neural network uses the examples to automatically infer rules for recognizing handwritten digits. Furthermore, by increasing the number of training examples, the network can learn more about handwriting, and so improve its accuracy. Neural Networks is taken over by Machine Learning methods. With advances in computer technology, we currently have the ability to store and process large amounts of data, as well as to access it from physically distant locations over a computer network. Most data acquisition devices are digital now and record reliable data.

Machine learning is a branch of science that deals with programming the systems in such a way that they automatically learn and improve with experience. Here, learning means recognizing and understanding the input data and making wise decisions based on the supplied data. Machine learning techniques improves the above said handwritten recognition system and advances it from offline handwritten technique to online. Machine learning techniques A well-known neural-network model where learning based on users data and image analytics is been synthesised using Machine Learning algorithms. Recent advances in deep learning methods based on artificial neural networks have led to breakthroughs in longstanding AI tasks such as speech, image, and text recognition, language translation, etc. Companies such as Google, Facebook, and

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Apple take advantage of the massive amounts of training data collected from their users and the vast computational power of GPU farms to deploy deep learning on a large scale. The unprecedented accuracy of the resulting models allows them to be used as the foundation of many new services and applications, including accurate text, speech and image recognition.

Various learning methodologies include Learning Association, Classification, Supervised Learning, Unsupervised Learning, and Reinforcement Learning. Among these techniques vast applications in computer vision includes Supervised and Unsupervised Learning.

In supervised learning, the aim is to learn a mapping from the input to an output whose correct values are provided by a supervisor. In unsupervised learning, there is no such supervisor and we only have input data. The aim is to find the regularities in the input. In some applications, the output of the system is a sequence of actions. In such a case, a single action is not important; what is important is the policy that is the sequence of correct actions to reach the goal. There is no such thing as the best action in any intermediate state; an action is good if it is part of a good policy. In such a case, the machine learning program should be able to assess the goodness of policies and learn from past good action sequences to be able to generate a policy. Such learning methods are called reinforcement learning algorithms.

When a linear model is not sufficient, non linear functions of input is required to build a linear model in space of new features. A better approach would be multilayer perceptron extracts new features in its hidden layer.

MultiLayer Perceptron→ Deep neural network →prediction of output

Further moving on to Deep learning (also known as deep structured learning, hierarchical learning or deep machine learning) is a branch of machine learning based on a set of algorithms that attempt to model high-level abstractions in data by using multiple processing layers, with complex structures or otherwise, composed of multiple non-linear transformations[1]. Moving on with the transition from NN to Deep learning the traditional Handwritten recognition problem blooms into Automatic handwriting recognition with a flavour of Deep learning which is of great academic and commercial interest. This is an example where there are multiple classes, as many as there are characters we would like to recognize. Especially interesting is the case when the characters are handwritten—for example, to read zip codes on envelopes or amounts on checks. People have different handwriting styles; characters may be written small or large, slanted, with a pen or pencil, and there are many possible images corresponding to the same character. Though writing is a human invention, we do not have any system that is as accurate as a human reader. We do not have a formal description of 'A' that covers all 'A's and none of the non-'A's. Not having it, we take samples from writers and learn a definition of A-ness from these examples. But though we do not know what it is that makes an image an 'A', we are certain that all those distinct 'A's have something in common, which is what we want to extract from the examples. We know that a character image is not just a collection of random dots; it is a collection of strokes and has a regularity that we can capture by a learning program.

Current algorithms already excel at learning to recognize handwritten digits. Post offices use them to sort letters; banks use them to read personal checks. Some predict that in the near future billions of handheld devices such as cell phones will have handwriting recognition capabilities.

Emerging areas wherein Deep learning has found its prominence is Biometric systems, Image analytics, Pattern recognition, Speech Recognition, Medical Diagnosis, Agriculture.

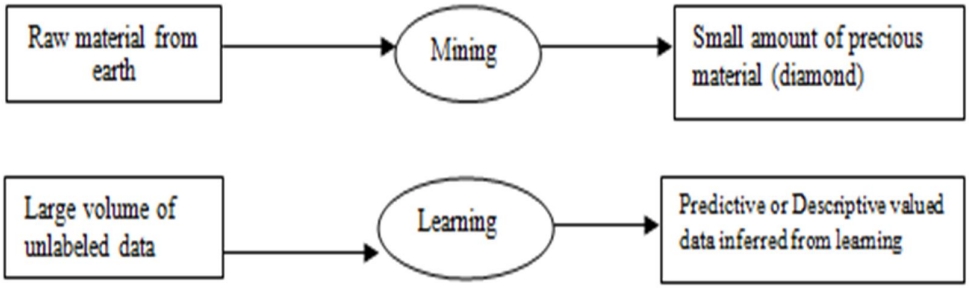

Fig. 1 Analogy of Mining and Learning process

II. INTRODUCTION TO DEEP LEARNING.

Deep Learning is learning representations or features. The first learning machine built was Perceptron-A Linear classifier on top of simple feature extractor. Most of the practical applications of ML uses linear classifier. ML transforms to Deep learning if it has more than one stage of non-linear transformation and hierarchy of representation with increasing levels of abstraction where each becomes trainable feature transform.

Example of an image transform would be Pixel→edge→texton→motif→part→object.

Text transform stages include Character →word→ word group →clause sentence →story transitions

Speech recognition techniques transform from sample→ spectral band→ sound →phone →phoneme to word.

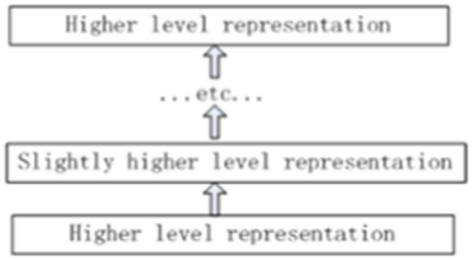

Fig 2 :Levels of Deep learning

The depth of neural networks refers to the number of nonlinear operation portfolio level in the function obtained is mostly neural network of shallow structure which consists of an input layer, a hidden layer and an output layer However, the network of higher nonlinear operation portfolio level is called deep structure neural network which consists of an input layer, three hidden layers and an output layer. Fig.1 is a typical deep learning model. Deep learning has many advantages compared to shallow learning: network structure of deep learning is the best simulation of the human cerebral cortex; Deep structure neural network can better represent the hyper variable functions and complex high-dimensional functions; when the larger deep network structure express a function, sometimes can significantly reduce the computational complexity. Using the training samples to adjust the parameter in the training factor, when a network structure has limited number of training sample and increased number of calculation factor, its generalization ability will become very poor. Depth learning can use repeatedly the extracted feature of the multiple levels obtained in the analogously different tasks [2].

A. Deep learning Models

Deep architectures is based on basic algorithms of Neural networks Feed-Forward: multilayer neural nets, convolutional nets Feed-Back: Stacked Sparse Coding, Deconvolutional NetsBi-Directional: Deep Boltzmann Machines, Stacked Auto-Encoders.

The typical deep learning models include convolution neural networks, deep belief networks and deep auto encoder [3].

B. Convolution Neural Network

Convolution neural network (CNN), generated by the inspiration of structure of the visual system, is the learning algorithm of training multilayer network structure. It uses spatial relationships to reduce the number of parameters need to learn in order to improve the training performance of the general former Back Propagation algorithm. CNN is a multilayer sensor neural network, each layer consisting of a plurality of two-dimensional plane, each plane defined by a plurality of individual neurons.

Convolution neural network CNN is mainly used for two-dimensional graphics recognition displacement, scaling and other forms of distortion invariance. It avoids explicit feature sampling type, implicitly learning from the training data. This feature of convolution neural network differentiates it from the other classifiers based on neural networks; network can parallel learn, and it is a big advantage of convolution network compared to neurons connected to each other. Each neuron of convolution neural network have very little input and hierarchical local connection structure, which makes the convolution neural network closer to biological neural network, it has unique advantages in speech recognition and image processing, in the field

of visual image processing experiments, and good results are obtained by feature extraction functional integration.

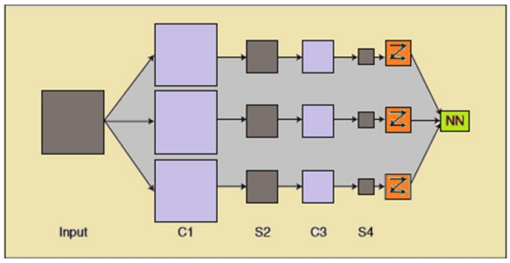

Fig 3. Basic Convolution Neural Network

C. Deep belief network

DBN is a directed acyclic graph which is composed of multiple random variables, directly connects a top-down form the above layer, the bottom unit state is visible input data vector, so the model is explained as Bias probability model generation. DBN can also connect several Restricted Boltzmann machine (RBM) unit to build a DBN through bottom-up. The network structure of RBM is depicted below in Fig 3: the visual layers and hidden layer units interconnect with each other (no connection layer); the hidden unit can obtain high order correlation of input visual elements. Compared with the traditional, sigmoid reliability network and RBM weights are relatively easy to learn.

D. Deep auto encoder

DAE is a kind of deep learning neural network structure and multilayer nonlinear network extracts layered characteristics of complex high dimensional input data through unsupervised layer for parameter optimization training and system. DAE uses this feature, and gets the distributed characteristic of the original data. DAE is comprised of the encoder, decoder and the hidden layer.

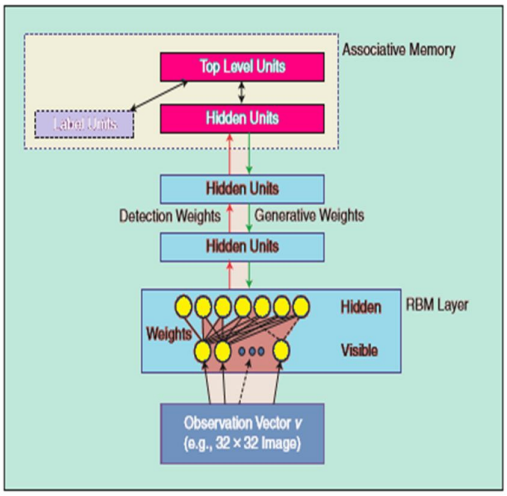

Fig 4. Basic Deep Belief Network

III. Research Avenues in Deep Learning.

Research in Deep learning area attempts to make better representations and create models to learn these representations from large-scale unlabeled data. Representations are inspired by advances in neuroscience and are loosely based on interpretation of information processing and communication patterns in a nervous system, such as neural coding which attempts to define a relationship between various stimuli and associated neuronal responses in the brain.

Biometric recognition is an emerging trend for researchers to contribute wherein recognition or authentication of people using their physiological and/or behavioural characteristics that requires an integration of inputs from different modalities. Examples of physiological characteristics are images of the face, fingerprint, iris, and palm; examples of behavioral characteristics are dynamics of signature, voice, gait, and key stroke. As opposed to the usual identification procedures—photo, printed signature, or password—when there are many different (uncorrelated) inputs, forgeries (spoofing) would be more difficult and the system would be more accurate, hopefully without too much inconvenience to the users. Deep learning uses separate recognizers for different modalities to get an overall accept/reject decision, taking into account how reliable these different sources are.

Agriculture is one the great frontiers for Appropriate application of deep learning methods which includes sensors, and data analytic allow the development of Precision Farming techniques which will in turn increase farm production .In this scenario the analysis of video data of animals in feeding-lots to monitor animal health and well-being. These systems use low-cost networked cameras which can be used to monitor multiple animals. Analysis will be based on Deep Learning based vision analysis systems which have recently been shown to provide accurate analysis of video information, even in noisy environments. It aims in the automated identification of hoof lesions in cattle.

Diffuse reflectance infra-red spectroscopy measurements estimates number of Functional properties of soil inexpensively and accurately. Deep learning Techniques maps high-dimensional spectra to real-valued outputs. Simple regression methods, correlates structure in the output variables to methods that can leverage this structure to make more accurate predictions. Advances in deep learning architectures, specifically convolutional neural networks and conditional restricted Boltzmann machines for structured output prediction for soil property prediction is of great research interest [4].

In computer vision and audio recognition, and outperformed other related handcraft designed feature is deployed using the convolution neural network. CNN uses some factors like network depth, numbers of filters, and filter sizes which gains CNN prime importance in AI. The used data set is the CIFAR dataset. Optical character recognition, which recognizing character codes from their images.

Huge amount of data collection required for deep learning poses several privacy issues. Users' personal, highly sensitive data such as photos and voice recordings is kept indefinitely by the companies that collect it. Data owners like, medical institutions who may want to apply deep learning methods to clinical records—are prevented by privacy and confidentiality concerns from sharing the data and thus benefitting from large scale deep learning [5]. Deep Learning also enables exact neural-network model without sharing their input valuable datasets. Optimization algorithms based on stochastic gradient descent, can be parallelized and executed asynchronously .Application areas like vision, speech, and robotics are also tasks that are best learned from sample data. Deep-learning-based Android malware detection engine (DroidDetector) is a recently developed app which automatically detect whether an app is a malware or not [6].

Caffe is a deep learning framework. The packages which support Deep Learning include **Torch7**, an extension of the LuaJIT language which includes an object-oriented package for deep learning and computer vision. The main advantage of Torch7 is that LuaJIT is extremely fast and very flexible.**Theano** + **Pylearn2**, which has the advantage of using Python (widely used), and the disadvantage of using Python (slow for big data).cuda-convnet, High-performance C++/CUDA implementation of convolutional neural networks.

IV. Conclusion

Though Deep Learning is applied in and all, emerging fields of research, varying from Agriculture to Web mining it still retains its infancy in obtaining robust models to real world learning problems. This paper provides a comprehensive knowledge of Neural networks, Machine learning, Deep learning architecture and its research avenues. Insights to various application areas of Deep learning provide a self promising note in designing a learning machine models.

References

[1] Itamar Arel, Derek C. Rose, and Thomas P. Karnowski 2010 Deep Machine Learning—A New Frontier in Artificial Intelligence Research The University of Tennessee, USA

[2] Li Deng, P. 2012 An Overview of Deep-Structured Learning for Information Processing Microsoft Research, Redmond,USA.

[3] Ping Kuang, Wei-Na Cao, Qiao Wu 2014 Preview On Structures And Algorithms Of Deep Learning 1School of Computer Science and Engineering, University of Electronic Science and Technology of China, Chengdu
[4] Reza Shokri1 and Vitaly Shmatikov2 2015 Privacy-Preserving Deep Learning Fifty-third Annual Allerton Conference Allerton House, UIUC, Illinois, USA.
[5] Matthew Veres, Griffin Lacey, Graham W. Taylor .2015 Deep Learning Architectures for Soil Property Prediction School of Engineering University of Guelph.
[6] Zhenlong Yuan, Yongqiang Lu, and Yibo Xue. 2000. DroidDetector: Android Malware Characterization and Detection Using Deep Learning Tsinghua Science And Technology.