

A Survey on Neural Networks and Its Applications

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Abstract: Now a day the term Machine Learning is playing a vital role in every industry. Machine Learning is a branch of computer science that enables a computer to learn without being programmed clearly. It gives a brief explanation of algorithms from which we can make predictions on data. Machine Learning is classified into two types: supervised learning and unsupervised learning. Artificial Neural Networks (ANN) is one of the Machine Learning algorithms which are inspired by the functionality of human brain. ANNs perform specific tasks on computer like classification, pattern recognition, clustering etc. Applications of ANNs in various disciplines include engineering, healthcare, nanotechnology, chemical engineering, bio technology, business and in other fields. In this paper, we give a brief description of ANNs in various fields and their applications and how they are playing an vital role in various applications. There are some merits and limitations which are mentioned.

Keywords: Machine Learning, Artificial Neural Networks, Unsupervised learning, supervised learning, ANN applications

1. INTRODUCTION

Machine Learning (ML) algorithms perform specific tasks by generalization from examples. If the data availability is more, more problems can be tackled. ML is used in various fields. ML systems consequently learn programs from the existing data [1]. For the past ten years ML has been used rapidly in computer science and beyond. There are various applications of ML which include web searching, fraud detection, stock trading, drug design and in other fields.

ML algorithms are classified into two types: supervised learning and unsupervised learning. If the instances are given with known labels then it is called as supervised learning. If the instances are given with unknown labels then it is called as unsupervised learning [2]. Examples of supervised algorithms are Artificial Neural Network (ANN), Support vector Machine (SVM) and Decision Trees.

The algorithms of unsupervised learning include k-means clustering, hierarchical clustering and self organization map.

ANN concept is taken from the subject of Biology where a neural network plays an important role in our human body. Neural network is interconnection of neurons which are present in millions of number. With these neurons, parallel processing is done in our body and hence it is the best example of parallel processing [3] [4].

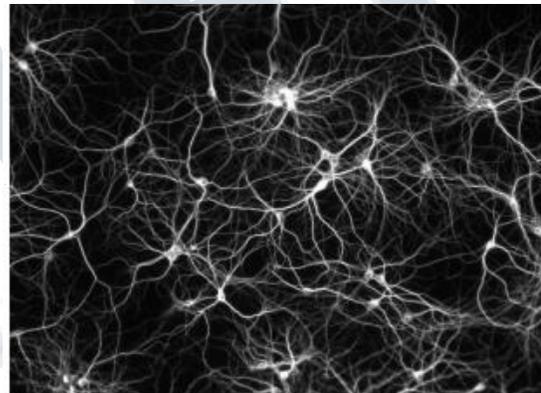


Fig1 Neural network in Human body [5]

Similarly ANN is a computing system containing large collection of units which are interconnected in some manner that allows communication between the units. These units are called as nodes or neurons which are

simple processors operate in parallel. The following are ANN types: Feed forward network, Feedback network.

Feed forward network:

It is a non-recurrent network containing nodes or units in layers and these are connected with previous layers nodes. In this, the signal flow only in one direction from input to output. There are two types in this: single layer feed forward network, multilayer feed forward network. In single layer feed forward network, there is only one weighted layer means the input layer fully connected to output layer.

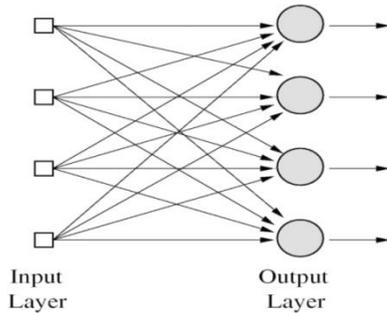


Fig2: A Simple Feed Forward Network [6]

In multilayer feed forward network, there are more than one weighted layers which contain hidden layer between input layer and output layer.

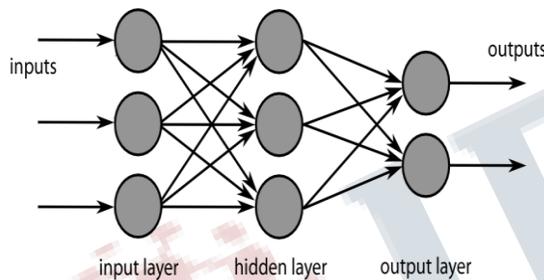


Fig3: Multilayer Feed Forward Network [6]

Feedback network:

This network contains feedback paths in which the signal flow in both the directions by using loops.

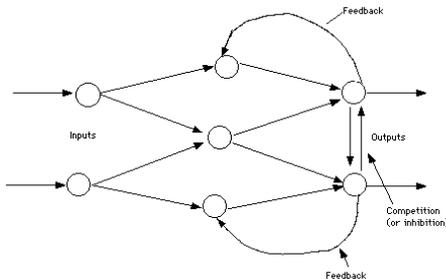


Fig4: Feedback Network [6]

This paper is organised as follows: section 2 discusses about the related work of different neural networks, limitations and merits of ANN. The applications of ANN in different domains are discussed in section 3. Finally the conclusions are discussed in section 4.

2. LITERATURE SURVEY:

For the past ten years the growth of neural networks in ML has been increasing containing multiple layers which is often known as Deep Neural Networks (DNN) [7]. DNNs are used as powerful models for specific tasks such as speech recognition and handwritten digit recognition [8]. Their success has been assigned to the hierarchy which is introduced due to several layers. Each layer performs some part of the task and passes it to the next. Therefore we can see DNN as a processing pipeline where each layer performs some part of the task, passing it to the next until the last layer provides the final output.

Another network for discussion in deep neural networks is the recurrent neural networks (RNN) which are super set of feed forward neural networks. Recently RNN is playing an important role in different fields such as computer vision, natural language processing, picture description and many others [9]. RNNs contain input units, output units and hidden units which play an important role in storing the end to end information. RNN introduced a directional loop that stores the previous information and apply it to the output which is the main difference from feed forward neural networks.

The Convolutional Neural Network (CNN) has shown good results in solving machine learning and computer vision problems. CNNs are widely used in Image related tasks such as image classification, image segmentation, detection of objects etc[10]. CNNs are similar to multilayer neural networks containing one or more convolutional followed by one or more fully connected layers. The advantage of designing CNNs is they are simple to train and have many parameters compared to fully connected networks with same number of hidden units. 2D structure of an image is achieved by the CNN architecture[11].

A.Limitations of Artificial Neural Network:

The ANN technology is weak in some points. The Limitations of ANN are as follows [12]:

1. Structured methodology is not present in ANN.
2. Black box nature.
3. Output of ANN may not be unpredictable.
4. Heavy Computational burden.
5. No standardized paradigms for ANN.

B.Advantages of Artificial Neural Network:

1. Adaptive learning.
2. Self organisation.
3. Flexible in changing environment.

4. Perform real time operations.
 5. Handling of very complex interactions.
 6. Recognises the patterns exist in the dataset.
3. Applications of Artificial Neural Networks(ANN):
Now we look into the applications of ANN in different domains [12] [13]. They are as follows:

A. Understanding Language:

It means the capability of understanding and giving response to the language. Language translation is done from spoken to written form and from one natural language to another natural language. ANN has areas in speech recognition, language translation and computational linguistics.

B. Marketing:

In general, we identify customers from the market, specify a product or service to them and we suggest advertising towards the product. Marketing is involved with segmentations where the customers are divided into different groups based on their behaviour. Neural networks show its excellent performance in segmentation of customers based on their characteristics that includes demographics, social economic status, purchase standards, and their behaviour towards the product.

C. Problem solving:

It means the ability of solving a problem and providing suitable solutions by obtaining the new information which is needed. ANN areas in problem solving include Interactive problem solving, automatic program writing, and Initial search.

D. Banking and Finance:

A neural network has improved many areas in banking and finance. Traditionally statistical techniques have been used to credit cards for determining the loan applicants they should lend money. But now day neural networks are playing a major role in decision making. They have been successful in identifying good or bad credits.

E. Telecommunications:

The uses of neural networks in Telecommunications include

1. Analysing the customer and call data details to identify fraud behaviour.
2. Improves quality of service and routing.
3. Understanding customer behaviour and developing new products and services.
4. Modification of subscriber calling plans.

F. Medical Area:

The growth of ANN in medical area has been increasing. ANNs are used for diagnosis of breast cancer, leukaemia. They identify ultrasound images of breast, ultrasound,

MRI images of brain tumours and vasodilators to control blood pressure.

G. Operations Management:

The use of ANN in operations management has been successful over many areas particularly in R&D, scheduling of machinery and planning. Operations Management gets benefited from neural networks in Quality control area. The Neural network has been used in various operations like demand forecasting, conjunction with simulation modeling and diagnostics.

The other applications of ANN include [13]

Table 1: Applications of ANN

Domain	Area
1. Business	Real Estate
	Marketing
2. Food Industry	Odor analysis
	Product development
	Quality of service
3. Energy Industry	Natural gas
	Hydro power
	Electric power
4. Manufacturing	Process control
	Quality control
5. Science and Engineering	Chemical engineering
	Weather forecasting
6. Identification & Control	Vehicle control
	Process control

4. CONCLUSION:

In this paper we discussed about Artificial Neural Network and their applications. Also few types of ANN. ANNs provide alternate solutions over conventional systems. ANN has the ability to do tasks efficiently compared with other supervised learning algorithms like J48, Naive Bayes and Random Forest. ANN allows users to quickly model the phenomena. ANN also plays a key

role in hardware development. ANN with computational automata and fuzzy logic can be used for various applications.

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