Classification Using ANN: A Review

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Abstract

Classification is one of the important areas of research in the field of data mining and neural network is one of the widely used techniques for classification. Present paper discusses about artificial neural network algorithm (ANN) and its variants and their use in classification. ANN has many advantages but it has some hindrances like long training time, high computational cost, and adjustment of weight. Researchers proposed different variants of it and hybridize it with evolutionary algorithm to improve its performance. Present paper discusses about ANN and its variants and their use for the classification using ANN and its variants and their performance results.

Keywords: Data mining, Classification, ANN, KDD, PSO, GA, ABC, ICS, ACO, Fuzzy Logic

1. INTRODUCTION

The amount of data is growing exponentially and it is necessary to analyze this huge amount of data to extract useful information from it. This led to emergence the field of data mining. Data mining refers to extracting knowledge from such large amount of databases. Data mining is core of KDD process. KDD is organized process of identified, valid, novel, useful and understandable pattern from large and complex dataset. [1]. Data mining tasks can be divided into two categories: descriptive and predictive. Predictive task include classification, regression, time series analysis and descriptive task include clustering, association rule [2]. These techniques can be used in specific areas. [3]Discuss about these technique and their application in various field. Data mining applications include various field such as sales, medicine, finance, marketing, healthcare, banking and insurance [4],[5],[6]. Classification is a data mining technique used for prediction of class of objects. It is an example of

supervised learning. Classification predict categorical label (discrete, ordered). Data classification involves two steps. First step is learning step (training step) in which a classifier is built to describe a predetermined set of data classes. In second step the model which is built in first step is used for classification of unknown data i.e. test data is used for estimating the classifier accuracy. There are many classification algorithms like decision tree, K nearest neighbor, naïve Bayesian classifier, and artificial neural network [7]. [8] Gives the comparative study of these classification algorithms. Artificial neural network is a machine learning technique used for classification problems.

ANN is a set of connected input output network in which weight is associated with each connection. It consists of one input layer, one or more intermediate layer and one output layer. Learning of neural network is performed by adjusting the weight of connection. By updating the weight iteratively performance of network is improved. On the basis of connection ANN can be classified into two categories: feed-forward network and recurrent network. Feed forward neural network is the network in which connections between units do not form cycle whereas in recurrent neural network connection form cycle [9]. The behavior of neural network is affected by learning rule, architecture, and transfer function. Neurons of neural network are activated by the weighted sum of input. The activation signal is passed through transfer function to produce a single output of the neuron. Non linearity of network is produced by this transfer function. During training, the inter connection weight are optimized until the network reaches the specified level of accuracy. It has many advantages like parallelism, less affected with noise, good learning ability [10]

Artificial neural network is applicable in various applications like pattern recognition [11] , medical [12], business applications [13], [14], pharmaceutical science [15], bankruptcy application [16], speech recognition[17] [18].

The most favorable point associated with neural network is comprehensibility, tolerance to noisy data, parallelism, and learning from example. The parallelism increases the speed of network. But besides these advantages it has also many disadvantages. First, training of neural network is costly and time consuming. Training of neural network plays an important role in classification accuracy. There are many algorithm used for training of neural network [19]. Neural networks have been criticized for their poor interpretability. For example, it is difficult for humans to interpret the symbolic meaning behind the learned weights and of "hidden units" in the network.

Present paper discusses artificial neural network and its variants proposed by many researchers for the improvement of the performance of neural network and their use in classification. The organization of paper is as follows: section 2 describes the ANN algorithm. Classification using ANN and learning of neural network by

traditional method and meta-heuristic method are described in section 3. Section 4 concludes the overall paper.

2. ARTIFICIAL NEURAL NETWORK ALGORITHM

ANN is a complex adaptive system which can change its internal structure based on the information pass through it. It is achieved by adjusting the weight of connection. Each connection has a weight associated with it. A weight is a number that control the signal between two neurons. Weights are adjusted to improve the result. Popular methods of learning are given as:

1. Supervised learning: This strategy involves a trainer which is smarter than the network.
2. Unsupervised learning: This strategy is used when there is not example data set with known answer.
3. Reinforcement learning: This strategy makes decision based on feedback from environment.

Artificial neural network is an example of supervised learning. Artificial neural network acquired the knowledge in the form of connected network unit. It is difficult for human to extract this knowledge. This factor has motivated in extracting the rule for classification in data mining. The procedure of classification is starts with dataset. The data set is divided into two parts: training sample and test sample. Training sample is used for learning of network while test sample is used for measuring the accuracy of classifier. The division of data set can be done by various method like hold-out method, cross validation, random sampling. In general learning steps of neural network is as follows:

- Network structure is defined with a fixed number of nodes in input, output and hidden layer.

- An algorithm is used for learning process.

The ability of neural network to make adjustment in structure of network and its learning ability by altering the weight make it useful in the field of artificial intelligence.

Algorithm 1: Learning of ANN

ALGORITHM
Input: dataset D, learning rate, network.
Output: a trained neural network.
Step1: receive the input.
Step2: weight the input. Each input sent to network must be weighted i.e. multiplied by some random value between -1 and +1.
Step3: sum all the weighted input.

Step4: generate output: the output of network is produced by passing that sum through the activation function

3. CLASSIFICATION USING ANN AND ITS LEARNING

The method of neural networks training is based on some initial parameter setting, weight, bias, and learning rate of algorithm. It starts its leaning with some initial value and weight gets updated on each iteration. The training of neural network is time consuming and it structure is complex. These feature made neural network less suitable for classification in data mining. Some method can be proposed to learn both the network structure and updating the weight. Adjustment of weight in ANN is combinatorial problem and to find the desired output we have to optimize the weight. Some learning methods for ANN in different classification problem are as follows:

a) Artificial neural network with back propagation

One variant of ANN with BP is proposed in [20]give application of neural network for classification of Landsat data. The back propagation algorithm is used for training of neural network. Other variant of ANN with BP is proposed in [21] is used for multispectral image classification. The BP is trained on classical area of image and then the neural network is used to classify the image.

b) Improved back propagation algorithm

[22]Discuss the training of neural network with back propagation algorithm using gradient delta rule. It is highly applicable for parallel hardware architecture. The momentum factor is determined on each step rather than being held constant. Improved BP has better speed and convergence stability than conventional BP.

Soft computing contains some meta-heuristic algorithms like cuckoo search, firefly algorithm, genetic algorithm, particle swarm optimization [23]. These meta-heuristic algorithms can be used for training of neural network. The meta-heuristic algorithms produce approximate result and applicable to any field. These algorithm are used where traditional algorithm produce local optimum. Traditional algorithm also increase computational cost and use more time to produce result. In previous studies many researchers combined ANN with these meta-heuristic algorithms to overcome its limitations. Some of them are discussed below:

1. ANN with Particle Swarm Optimization(PSO)

An evolutionary system which is a combination of architectural evolution with weight learning, called PSONN, to improve the performance of artificial neural network was proposed in [24]. The results are depends on initial network architecture in some structural methods like hill climbing which are susceptible to become trapped at structure local optima. The PSONN which is a hybrid technique is applied

on two problems in medical domain: breast cancer and heart diseases. A hybrid technique which gives the advantage of two techniques ,PSO and BP which uses global searching of PSO and local searching ability of BP, was suggested in [25]. This hybrid technique gives better classification accuracy and reduces the CPU time as compared to BP. It is applied on the iris classification problem. [26] Proposed a hybrid technique of PSO, ABC and single hidden layer feed forward neural network for fruit classification.

2.   ANN with Genetic Algorithm(GA)

[27] Propose a novel hybrid neural network structure for classification of ECG beat. It uses to determine the weight and number of node in first layer of neural network. [28] This paper presents the application of genetic algorithm with neural network in land cover classification of remotely sensed data. It uses real coded GA hybrid with back propagation. Genetic operator are used for optimized the neural network, avoiding premature convergence. BP algorithm is applied on GA to find initial connection weight.

3.   ANN with Artificial Bee Colony (ABC)

[29] Proposed a methodology for classifying DNA microarray. ABC is used for dimensionality reduction to select best set of genes to find out particular diseases and then these reduced genes is used to train ANN to classify the DNA microarray. [30] Present a hybrid method of forward neural network (FNN) and improved ABC to classify an MR brain image as normal or abnormal. Parameters of FNN are optimized using improved ABC which is based on both fitness scaling and chaotic theory. [31] Use the ABC algorithm to train the neural network for classification problem in medical field. The hybrid technique is applied on nine different real world problem of medical domain.

4.   ANN with improved cuckoo search (ICS)

[32]Used the improved cuckoo search for training of neural network. Cuckoo search is inspired by the behavior of cuckoo species which laying their egg in nest of host species. Improved cuckoo search is different from standard cuckoo search in terms of parameter. The parameter p_a and alpha are used to find globally and local improved solution. It enhances the accuracy and convergence rate of algorithm. Standard cuckoo search use fix value of these parameter.

5.   Training of ANN with Ant Colony Optimization(ACO)

[33] Used ACO for optimization of weight of neural network. It trains the neural network for pattern classification. [34] used the hybrid technique (ACO and BP) for training of ANN. Back propagation (BP) trapped into local optima. So this hybrid training is to use global optimization algorithm to provide BP with good initial

weight. Both these is applied for classification of data in medical domain: cancer dataset, diabetes and heart dataset.

6.   ANN with tabu search

[35] Proposed a system which hybrid the four techniques namely genetic algorithm simulated annealing, tabu search and back propagation is used for neural network training. Simulated annealing also have uphill property (occasionally accept bad moves). GA is characterizing by parallel search. Tabu search is characterized by flexible memory. The proposed system combine all these feature. The proposed technique is applied on four classification problem and one prediction problem.

7.   ANN with GSA (gravitational search optimization)

[36] Propose an iris recognition system. It gives two hybrid techniques FNNPSO and FNNGSA for iris classification. It is four step processes: acquisition of image, segmentation, normalization, feature extraction and then classification using ANN. Both PSO and GSA is applied to train neural network that give optimum weights and biases.

8.   ANN with biogeography based optimization

[37] Propose a fruit classification method which uses shape, color and texture feature. Biogeography based optimization algorithm is used for updating the weight of neural network.

9.   ANN based fuzzy logic

[38]Proposed neural network model for fuzzy logic control and decision system. Such fuzzy and decision system can be constructed from training example of neural network and connectionist structure can be trained to develop fuzzy logic rule and find input output relationship.

4. CONCLUSION

After study of many research paper it is concluded that there are many limitation associated with artificial neural network despite of its advantages. Problem associated with neural network is mainly its training. Traditional algorithm like back propagation is used for training of neural network but these have problem of local minima. Nature inspired algorithm is also used for training of neural network. These nature inspired algorithm is useful in finding global optima. For example genetic algorithm perform parallel search so it improve computational speed. Tabu search provide flexible memory. Ant colony optimization (ACO) is used for optimization of weight. Improved cuckoo search provide flexibility to parameter so it improve the accuracy and speed. So from overall observation it is concluded that performance of ANN can be improved in terms of accuracy and training time.

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