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A Survey on Application of Artificial Neural Networks for Classification

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Abstract - *Artificial Neural Networks play a vital role in data mining applications because of their dynamic processing capabilities. Classification is a major activity of data mining which finds a place in medical field, market sales analysis, engineering applications, satellite image processing, digital image recognition, pattern matching etc. Classification is one of the most dynamic research areas in Artificial Neural Network. This paper provides the framework for the investigation of usage of Artificial Neural Networks for classification.*

Keywords – *Data mining, Classification, Artificial Neural Network*

I INTRODUCTION

In cognitive science, artificial neural networks (ANNs) are a family inspired by human or animal neural networks and are used to recognize patterns that use a large number of inputs. Artificial neural networks are generally represented by a network of interconnected "neurons" which trigger messages between each other. The connections have numeric weights that can be improved based on experience, making neural nets capable of learning.

Examinations of the central nervous system of human beings inspired the concept of artificial neural networks. In artificial neural network, the simple artificial nodes, called as "neuronss" or "neurodes" or "processing elements" or "units" which are connected together to configure a network which impersonate a biological neural network. A class of statistical models may commonly be called "neural" if it contains set of adaptive weights and the capability of handling non-linear functions of inputs.

The word *network* refers to inter–connections between the neurons in the different layers of each system. ANN is typically defined by the interconnection pattern between the different layers of neuron, the learning process for upgrading the weights of the interconnections, the activation function that converts a neuron's weighted input to its output activation.

The tasks of artificial neural networks fall within the following broad categories:

- Function approximation, or analysis of regression.
- Pattern recognition, novelty detection and sequential decision making
- Data processing
- Robotics

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1.1 Generalization and Statistics

The problem of over-training has emerged in applications whose goal is to create a system that generalizes well in unseen examples. This arises in convoluted systems. There are the two methods for thought to avoid this problem: The first is to use cross-validation and check for the presence of over training and select hyper parameters. The second is to use a form of *regularization*. This concept emerges naturally in a probabilistic (Bayesian) framework.

1.2 Confidence Analysis of a Neural Network

Supervised neural networks use a mean squared error (MSE) metric to determine the confidence of the trained model. The MSE on an affirmation set can be used as an estimate for variance. This value can be used to calculate the confidence interval of the output network. A confidence analysis thus made is statistically valid as long as the output probability distribution stays the same and the network is not modified.

1.3 Classification using Neural Networks

By allotting a soft-max activation function, a generalization of the logistic function, for target variables, the outputs can be expound as posterior probabilities. This is very useful as it gives a certainty measure on classifications.

The soft-max activation function is:

$$y_i = \frac{e^{x_i}}{\sum_{j=1}^{c} e^{x_j}}$$

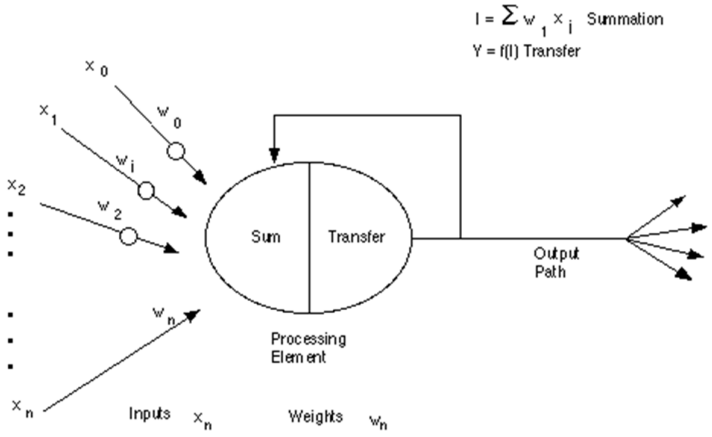

Figure 1.1 A Basic Artificial Neuron.

The ANN is used primarily for finding the most accurate group of training, learning and transfer function for the classification of datasets with increasing number of features and classification sets. Using different datasets and ANN as a classifier, different combinations of functions and its effects are studied. The accuracy of correctness of these combinations of functions is analyzed. Initially, the dataset is divided into testing set and training set. 1/3rd of the dataset i1s taken for test set and 2/3rd of the dataset is taken for training set. Then the neural network is simulated with this data. The back propagation algorithm is used to train the neural network. The metrics for Artificial Neural Network models are Rate of convergence, No. of epochs and Mean Square Error (MSE).

II Literature Survey

2.1 Classifying IRS-1D Satellite Images was proposed by E. Hosseini Aria, J. Amini, M. R. Saradjian [1].

This paper proposes classifying IRS-1D Satellite Images. It uses the BPNN method. The network has three layers. The input layer contains 18 neurons. The classification of IRS-1D satellite images used 6 classes and back propagation was used to train them. Iranian

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regions were taken for testing. The gradient was determined by back propagation and accuracy in MLC method is 75.00% and 85.19% in BPNN method.

2.2 Remote sensing image classification using artificial neural network was proposed by Yu-guo Wang, Hua-peng Li (2010) [2]

Artificial neural network has been widely used in the field of remote sensing. This article proposed a new method by filtering the samples based on statistical analysis theory for sample purification, to enhance the classification. By experiments it is proved that this proposed method is efficient for image classification.

2.2.1 Multi-Category Classification

Section 1: A multi-category classification method is presented by combining one-versus-all or one-versus-one binary classifiers, through soft-max function. Hence, Posteriori probabilities are obtained.
Section 2: Various designs of soft-max combining functions are presented.
Section 3: Practical implementation issues are given.
Section 4: Numerical experiments are given by comparing proposed methods with other implementations.
Section 5: Results are analyzed and concluded.

2.3 Multi-Category Classification by Soft-Max Combination of Binary Classifiers was proposed by Kaibo Duan, S. Sathiya Keerthi, Wei Chu, Shirish Krishnaj Shevade2, and Aun Neow. [3]

The proposed soft-max combination methods with simplified combination function design are better than their 'usual' counterparts. Pair-wise t-test is conducted to compare and analyze which method has greater errors. We compute p-values, for all the available datasets. Close classification accuracy and probability is better in soft-max combination of one-vs-one classifier .Through this proposed combination method of soft max new alternatives of doing multi-category classification with binary classification methods is achievable.

2.4 Intelligent Classifier model using Hybrid ELMAN Neural Network Architecture with Bio-geography Based Optimization for Data Classification was proposed by N. Mohana Sundaram and S. N. Sivanandam. [4]

A novel hybrid ELMAN – BBO based algorithm is proposed in this research paper that hybridizes the ELMAN recurrent neural network model and Bio-geography based Optimization to perform data classification process for the available datasets. BBO technique is employed in this process in order to optimize the input weights and hidden weights. The aim of this hybridization is to improve performance and achieve better classification accuracy with minimal MSE, minimal iterations and less computational time. This hybridization technique has been efficient than other available methods. The outputs prove that this model achieves increased classification accuracy and generalization capability.

2.5 Multi-Label Classification

In this type of classification, each sample can be associated with a set of class labels. When the number of labels increases, existing multi-label classification methods become inefficient. Many number of alternatives have been proposed. But, they are based either on regular dimension reduction techniques or involve expensive optimization problems. In this method, we approach this problem by selecting a small subset of class labels and can approximately span the existing label space. This is achieved by an efficient randomized sampling procedure. Experiments on a number of real world multi-label data sets with many labels demonstrate the increased performance and efficiency.

2.5.1 Multi-Label Classification: An Overview was proposed by Grigorios Tsoumakas, Ioannis Katakis Department of Informatics, Aristotle University of Thessaloniki, 54124, Greece[5]

Multi-label classification methods are required by modern applications such as protein function classification. This paper proposes the task of multi-label classification and organizes the sparse related literature into a structured presentation and also contributes the definition of quantification concepts of the multi-label nature of a data set. Traditional single-label classification is about learning from a set of examples associated with a single label from labels L, $|L| > 1$. If $|L| = 2$, then the learning problem is known as binary classification problem while if $|L| > 2$, then it is known as multi-class classification problem. The paper aims to serve as a reference for researchers who are interested in multi-label classification. Thus, multi-label classification provides comparative experimental results for some of these methods.

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2.6 Efficient Multi-label Classification with Many Labels was proposed by Wei Bi, James T. Kwok, Department of Computer Science and Engg., Hong Kong University of Science and Technology [6]

In multi-label classification, each sample is associated with a set of class labels. When the number of labels grows, existing multilabel classification methods often become computationally inefficient. The remedies proposed in recent years are based on simple dimension reduction techniques. This paper proposes the problem by selecting a small sub-set of class labels that can span the original label space approximately. It is performed by an efficient randomized sampling procedure. The probability of sampling of each class label shows its importance among all the labels. Binary Relevance, a basic approach to multi-label classification trains classifier for each label. This is an efficient approach for handling multi-label classification problems with many labels. The label selection approach, samples the more important labels by considering it as a column Subset selection problem. The number of trials used in this proposed algorithm is adaptive. Hence, the theoretical analysis shows that the proposed sampling approach is highly efficient. It obtains a good approximation of the label matrix, and also a good multi-label classification performance bound. Experiments performed on a number of real-world data sets with large number of labels indicate that the proposed algorithm is effective and efficient as compared to the other recent multi-label learning algorithms.

2.7 Neural Network Approach for Automatic Landuse Classification of Satellite Images: One against- Rest and Multi-Class Classifiers was proposed by Anil Kumar Goswami, Heena Joshi, S.P. Mishra. [7]

In this paper the authors proposed an Artificial Neural Network approach for land use classification using satellite images using Multi Layer Perceptron (MLP).They used two method One Against Reset Classification (OARC) and Multi-Class Classification(MCC). To reduce manual efforts Automatic land use classification is necessary, which can be achieved by making use of machine learning techniques. ANN is an important method for Automatic landuse classification from satellite information by using EBP as a learning algorithm. In this experiment has shown the strength of the MLP as a good classifier for accuracy of results of training and testing data for image classification and various other applications of remote sensing. Therefore, MCC should be used because it has significantly more accuracy than OARC. Overall the use of Artificial Neural Network for automatic extraction of landuse map from satellite image is very promising and should be incorporated in related applications.

III Conclusion

The study proves that the Artificial Neural Network are more suitable for Classification of various applications in various fields of engineering technology, medicine and remote sensing with a good accuracy. Making use of ANN in such applications, training and testing data should be pre processed carefully to make them robust, reliable and consistent. To the best of our knowledge, this review paper highlighting the interesting and integrating the task classification including multi class classification. Future we intend to perform a finer-grained categorization of the different multi-label classification methods and develop more extensive experiments with more information and methods.

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