ADVANCES IN PATTERN CLASSIFICATION USING IMPROVED ANN, SPIKING NEURAL NETWORK AND DECISION TREE

by

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Certificate

This is to certify that the thesis entitled which is being submitted by **Mr. VENKATANARESHBABU KUPPILI** for the award of the degree of **Doctor of Philosophy in the Department of Mathematics** to the **Indian Institute of Technology, Delhi**, is a bona fide research work done under my guidance and supervision.

The thesis has reached the standard fulfilling the requirements of the regulations relating to the degree. The results obtained in the thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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Abstract

The thesis aims to evolve improved Architecture for Artificial Neural Network models and efficient Decision tree techniques for pattern classification. New spiking Neural Network models have also been developed for pattern classification. The potential of various proposed algorithms is supported by analytical results and numerical simulations. The focus is on Neural Network architectures in terms of internal and topological adjustments. Development of internal adjustments is based on formulating a new algebraic activation function called Parametric Algebraic Activation function (PAA) for Multilayer Perceptron (MLP). It satisfies all the important properties that an activation function should satisfy. PAA performs superior as compared to transcendental activation functions in terms of classification accuracy. Topological adjustment in MLP is also important since more than the required number of hidden neurons causes overfitting. A new hidden node pruning algorithm called Fisher score pruning algorithm has been developed in the thesis to decide the number of hidden neurons. FPA computes hidden node relevance values using continuous activations and target vector without loss of information. An Improved Architecture for Probabilistic Neural Network (IAPNN) has also been formulated to reduce the number of layers in Probabilistic Neural Network (PNN) IAPNN contains only three layers in contrast to PNN which contains four layers. It is shown that IAPNN takes very less computational time to classify an unknown pattern when compared to PNN.

Neural Networks have also been visualized from the biological point of view. Various new spiking neuron models have been developed. The interspike intervals has been as an aggregation function in Wavelet Radial Basis Neural Network (WRNN) and multiplicative single neuron models for pattern classification. Finally, a new split measure has been designed using local and global information at a split point to construct a compact decision tree for pattern classification.

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