Thesis: The N-Tuple Subspace Method

Abstract: In the standard conceptualization of the multilayer perceptron type neural networks, the time complexity for adjusting the weights during multiple iterations not only makes the neural network model slower but also causes an increase in its computational complexity. An alternative approach to the traditional model of neural networks is a descendant from the family of the random subspace classifiers: the N-tuple subspace method. In this approach, we have a different type of a neuron; look-up tables, and the learning is performed by training the model with the randomly generated the subspaces of the input space. The classification is then made by a simple scoring function picking the majority vote, after combining the scores in the look-up tables. This distinct approach makes the N-Tuple Subspace Method a high-speed, efficacious memory-supported neural network, competent in the classification of patterns and executing non-linear function approximations. This proposal explains the N-Tuple subspace method by using the language of indexed relation and using the mathematical notation to represent the whole neural network and the iterative optimization techniques we developed as mathematical multivariate functions. We use the Simultaneous Perturbation Stochastic Approximation algorithm to apply the optimization on the N-tuple subspace method. More crucially, we propose the optimization of the model, such that its capabilities of the pattern classification are maximized, and the error rate is minimized. We hypothesize the existence of a neural network model with zero error rate, at least in the training set, based on the Kolmogorov-Arnold's approximation theorem which, establishes that any simple function of multiple variables is somehow equivalent to superpositions of the functions of single variables.

Keywords: Random Subspace Classifier, The N-Tuple Subspace Method, Optimization of the N-Tuple Subspace Method, Kolmogorov-Arnold's Approximation Theorem, Simultaneous Perturbation Stochastic Approximation Algorithm.

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