Neurocomputing 75 (2012) 1–2

Contents lists available at ScienceDirect

Neurocomputing

journal homepage: www.elsevier.com/locate/neucom

Editorial

Automatic parameters selection in machine learning

Parameter selection plays a central role in machine learning. The main idea of parameter selection is to choose a subset of relevant parameters for building robust learning models. There are many potential benefits of parameter selection: facilitating data visualization and data understanding, reducing the measurement and storage requirements, reducing training and utilization times, defying the curse of dimensionality to improve prediction performance.

There are ad hoc parameter selection techniques, but there are also more methodical approaches. From a theoretical perspective, it can be shown that optimal parameter selection requires an exhaustive search of all possible subsets of parameters. If large numbers of parameters are available, this is impractical. For machine learning, the search is for a satisfactory set of parameters instead of an optimal set. A great deal of research in machine learning has focused on the development of automatic parameter selection algorithms for which many algorithms and datasets with tens or hundreds of thousands of variables are available.

Support Vector Machines (SVMs) have achieved very good performance on different learning problems. However, the success of SVMs depends on the adequate choice of the values of a number of parameters, (e.g., the kernel and regularization parameters). Paper 1, *Combining Meta-Learning and Search Techniques to Select Parameters for Support Vector Machines by Taciana Gomes, Ricardo Prudencio, Carlos Soares, Andre Rossi and Andre Carvalho*, proposes the combination of Meta-Learning and Search algorithms to deal with the problem of SVM parameter selection. In this combination, given a new problem to be solved, Meta-Learning is employed to recommend SVM parameter values based on parameter configurations that have been successfully adopted in previous similar problems. The parameter values returned by Meta-Learning are then used as initial search points by a search technique, which will further explore the parameter space. The experimental results on a set of 40 regression problems showed that, on average, the proposed methods obtained lower error rates when compared to their components applied in isolation.

Neural network can be successfully used for classification problems but several parameters need to be defined. Architecture and synaptic weights of the neural network can be defined automatically by a learning procedure. Paper 2, *A constructive algorithm to synthesize arbitrarily connected feedforward neural networks by Wilfredo Jaime Puma-Villanueva, Euri´pedes dos Santos and Fernando Von Zuben*, presents a constructive algorithm capable of producing arbitrarily connected feedforward neural network architectures for classification problems. The main purpose of the algorithm is to obtain a parsimonious neural network, in the form of a hybrid and dedicate linear/nonlinear classification model, which can guide to high levels of performance in terms of generalization. A set of benchmark experiments, including artificial and real datasets, indicates that the new proposal presents a favorable performance when compared with alternative approaches in the literature, such as traditional MLP, mixture of heterogeneous experts, cascade correlation networks and an evolutionary programming system, in terms of both classification accuracy and parsimony of the obtained classifier.

Meta analysis of supervised machine learning algorithms for pattern recognition, by using a methodology that relates the classifier's behavior to the data characteristics, has been receiving a great deal of attention. In the third paper, *Analysis of Complexity Indices for Classification Problems: Cancer Gene Expression Data by Ana C. Lorena, Ivan G. Costa, Newton Spolaôr and Marcilio C. P. de Souto*, of this issue, Lorena et al. present, using classification complexity indices, a meta analysis of gene expression datasets for cancer diagnosis. Such indices measure statistics of data geometry, topology and shape of the classification boundary. Their results show that some of the characteristics of cancer gene expression data do influence the classification performance of the classifiers built. The most important aspects are related to data sparsity and class unbalance. They also showed that, when a dimensionality reduction is accomplished by a proper feature selection, the impact of these characteristics tends to be decreased.

The interest for Many-Objective Optimization has grown due to the limitations of Pareto dominance based Multi-Objective Evolutionary Algorithms when dealing with problems of a high number of objectives. Paper 4, *Measuring the Convergence and Diversity of CDAS Multi-Objective Particle Swarm Optimization Algorithms: A study of Many-Objective Problems by Andre B. de Carvalho and Aurora Pozo*, presents a study of the behavior of Multi-Objective Particle Swarm Optimization (MOPSO) algorithms in many-objective problems. The many-objective technique named Control of Dominance Area of Solutions (CDAS) is used on two multi-objective particle swarm optimization algorithms. An empirical analysis is performed to identify the influence of the CDAS technique on the convergence and diversity of MOPSO algorithms using three different many-objective problems. The experimental results are compared applying quality indicators and statistical tests.

In paper 5, *Classical and Superposed Learning for Quantum Weightless Neural Networks by Adenilton Silva, Wilson R Oliveira and Teresa B Ludermir*, a supervised learning algorithm for quantum neural networks (QNN) based on a novel quantum neuron node implemented as a very simple quantum circuit is proposed and investigated. The proposed model can both perform quantum learning and simulate the classical models. These

0925-2312/$ - see front matter
doi:10.1016/j.neucom.2011.07.008

quantum weightless neural networks can inherit the theoretical and practical results of weightless neural networks. In the quantum learning algorithm proposed here patterns of the training set are presented concurrently in superposition. This Superposition Based Learning Algorithm has computational cost polynomial on the number of patterns in the training set.

This special issue includes five papers selected among the best contributions to the XI Brazilian Symposium on Neural Networks, XI SBRN, which took place in São Bernardo do Campo, Brazil, from October 23 to October 28 2010. The Symposium covered topics related to Computational Intelligence, including Artificial Neural Networks, Evolutionary Computation, Fuzzy Systems and other Computational Intelligence approaches. XI SBRN received papers related with theoretical and practical aspects of Computational Intelligence. SBRN is an international conference, with papers written in English, an international program committee composed by well known researchers from all over the world, and proceedings published by IEEE Computer Society.

The XI SBRN received 94 submissions from several different countries. Among these submissions, 44 full papers were accepted for oral presentation. The authors of the papers with the best reviews were invited to submit an extended and updated version for this special issue. The selection process emphasized three main aspects: originality, relevance and technical contribution. The new versions were submitted to a rigorous peer review process conducted by international reviewers. Only the papers recommended by the reviewers were accepted for this special issue. In the end of this new review process, 5 papers were selected. We believe that this issue presents a set of very high quality papers. As a result, this edition will provide the readers a rich material of current research on Automatic Parameters selection in Machine Learning and related issues.

We would like to thank all the authors for their effort to submit high quality papers and the referees for their meticulous and useful reviews with relevant comments and suggestions that surely improved the quality of this special issue. We would also like to thank the Neurocomputing Editor-in-Chief Tom Heskes, the Journal Editorial Board and Elsevier for the opportunity and for efficiently handling the publication procedure. Finally, we would further like to acknowledge Vera Kamphuis and Vijayakumar Raman for their help and careful edition of this issue.

Teresa B. Ludermir *, Marcilio C.P. de Souto
Universidade Federal de Pernambuco, Brazil
E-mail addresses: tbl@cin.ufpe.br, teresa.ludermir@gmail.com (T.B. Ludermir), mcps@cin.ufpe.br (M.C.P. de Souto)

Marley Vellasco
Pontifícia Universidade Católica do Rio de Janeiro, Brazil
E-mail address: marley@ele.puc-rio.br

* Corresponding author.