

SS11: Soft Computing Techniques for Machine Learning

Mikel Galar

Universidad Publica de Navarra
Institute of Smart Cities
Campus Arrosada s/n, 30006 Pamplona (Spain)
mikel.galar@unavarra.es

Jose Antonio Sanz

Universidad Publica de Navarra
Institute of Smart Cities
Campus Arrosada s/n, 30006 Pamplona (Spain)
joseantonio.sanz@unavarra.es

This special session is aimed at discussing recent and novel fuzzy methods to deal with the current challenges on machine learning. This research field is very active due to the large number of real-world problems that can be faced using techniques of this field. The canonical problems of this area of research are classification, regression and clustering. However, in recent years there are a great number of hot topics like the problem of imbalanced data, low quality and/or noisy instances, semi-supervised learning or multi-label and multi-instance problems among others.

When tackling the previously mentioned problems, soft computing techniques are widely applied. Specifically, fuzzy systems are a common tool as they provide an interpretable model understandable by human beings whilst the results obtained are accurate, since fuzzy logic has an inherent ability to cope with the great uncertainty present in these new challenging problems. Evolutionary computation is a robust technique for optimization, learning and adaptation tasks. They can adjust the model parameters for each specific problem for the sake of enhancing their performance. The synergy between these two techniques leads to a better capability for the design and optimization of fuzzy models. Moreover, Big Data also offers new possibilities for fuzzy methods, where new challenges appear with respect to their scalability when dealing with enormous amounts of data.

The special session is composed of seven contributions dealing with different topics of the machine learning field.

- The work by R. Kamimura and H. Takeuchi deals with the problem of vanishing information in multi-layered neural networks. That is, when the information in the original data set gradually decreases in the intermediate hidden layers. They propose a supervised semi-autoencoder, which increases the information of the outputs to amplify the information. Furthermore, they also make use of potential learning to avoid the process of parameters' adjustment.
- In the contribution entitled "Associated Multi-label Fuzzy-rough Feature Selection" authors propose a feature selection method for multi-label problems. Specifically, the new approach combines association rules and fuzzy rough set theory to reduce the scale of label and avoid the label overlapping phenomenon. As a result, a set of sub-labels is obtained and thereafter, each set of sub-labels is considered as a unique class during the fuzzy-rough feature selection process.

- N. Yamaguchi develops a new nonlinear dimensionality reduction technique for time series. This new method extends the Gaussian process dynamical model and it is aimed at easing the visualization and understanding of the evolution of the states over time.
- Multi-class classification problems are faced in the work by Elkano et al.. In order to do so, they develop one of the first approaches for combining interval-valued fuzzy rule-based classification systems with the one-versus-one decomposition technique. They propose a normalization technique of the interval score-matrix as well as the extensions of three voting strategies to handle interval information.
- K. Tatsumi et al. propose a software-level calibration method, which is based on the least square method, for the successive stochastic approximation of low-power high-precision analog-to-digital converters. Additionally, they also make usage of incremental learning methods based on Bayesian predictive distributions to reduce the number of training data required.
- The work of J.-J. Huang copes with the problem of mining association and sequential rules from distributed databases. Furthermore, their new approach is able to derive decision rules including the non-occurrence of items as they can be important in some domains of application. These type of rules cannot be generated by the conventional association or sequential rule algorithms.
- Finally, in the work entitled “Michigan-style Fuzzy GBML with (1+1)-ES Generation Update and Multi-Pattern Rule Generation” authors deal with classification problems. Specifically, they develop a new fuzzy rule learning method taking advantage of the computational efficiency of Michigan style genetic algorithms and using the (1+1) Evolutionary Strategy to perform a direct optimization of the rule set, which cannot be directly carried out by the former technique. Furthermore, the new method enables the generation of fuzzy rules from multiple patterns in a heuristic manner.

Looking at the topics of the contributions conforming the special session, the importance of soft computing techniques in general and fuzzy methods in particular in the field of machine learning becomes clear. Consequently, this special session enriches the conference with several new techniques to deal with real-world problems.