Guest-Editorial

Special issue on Hybrid Intelligence using rough sets

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The problem of imperfect knowledge under uncertain environments has been tackled for a long time by philosophers, logicians and mathematicians. Rough set theory proposed by Zdzislaw Pawlak [1] has attracted attention of many researchers and practitioners all over the world, and has a fast growing group of researchers interested in this methodology.

Fuzzy set theory proposed by Lotfi Zadeh [2] helps to understand and manipulate imperfect knowledge. Fuzzy sets are defined by partial membership, in contrast to crisp membership used in classical definition of a set. Rough set theory, expresses vagueness, not by means of membership, but employing a boundary region of a set. The back bone of rough set theory is the approximation space and lower and upper approximations of a set. The approximation space is a classification of the domain of interest into disjoint categories. The lower approximation is a description of the domain objects which are known with certainty to belong to the subset of interest, whereas the upper approximation is a description of the objects which possibly belong to the subset. Any subset defined through its lower and upper approximations is called a rough set. The main advantage of rough set theory is that it does not need any preliminary or additional information about data – like probability in statistics, grade of membership in fuzzy set and so on. Readers may consult the International Rough Set Society Web page [3] for more online resources, publications etc.

The Third International Conference on Hybrid Intelligent Systems (HIS'03) gathered individual researchers who see the need for synergy between various intelligent techniques. This special issue comprising of four papers is focused on hybrid intelligence using rough set theory and its applications. Papers were selected on the basis of fundamental ideas/concepts rather than the thoroughness of techniques deployed. The papers are organized as follows.

In the first paper, Polkowski proposes a framework for hybridizing rough, fuzzy and neural computational models. The concept is based on rough mereology and by having rough inclusions that are logical connectives of rough mereology it is possible to construct granules of knowledge that constitute elementary objects for calculi merging rough, fuzzy and neurocomputing schemes. The idea of rough inclusions provide a bridge between rough and fuzzy theories linking them across the gap resulting from distinct approaches to model uncertainty of knowledge.

Inuiguchi, Greco and Slowinski in the second paper present a fuzzy rough set approach to induce gradual decision rules from decision tables without using any fuzzy logical connectives. The use of gradual decision rules within modus ponens and modus tollens inference patterns are discussed. Differences and similarities between modus ponens and modus tollens are also presented with comparison between linear regression analysis and the proposed approach.

In the third paper, Minz and Jain present a hybrid rough set and classical decision tree induction algorithm for data mining applications. The proposed Rough set based Decision Tree (RDT) algorithm is also optimized using genetic algorithms. RDT algorithm is validated using some benchmark datasets. To measure the performance of the algorithms accuracy, complexity, number of rules and attributes are taken into account.

In the last paper, Hung Son Nguyen and Sinh Hoa Nguyen propose a method for decision tree construction from large data set, stored in some database server and accessible by SQL queries. A decision tree construction method is presented which minimizes the total time of data transmission between client and server. The method, based on 'divide and conquer' search strategy, minimizes the number of simple queries necessary to search for the best cuts. Authors developed some 'approximate measures', defined on intervals of attribute values; to evaluate the chance that the best cut is belonging to the given interval. The approach is validated using some applications in discretization and construction of a soft decision tree. Experiment results reveal that it is it is possible to reduce the number of simple queries from O(N) to O(logN) to construct the partition very close to the optimal one.

The editors wish to thank the referees who have critically evaluated the papers within the short stipulated time. Finally we hope the reader will share our joy and find this special issue very useful.

References

[1] Z. Pawlak, Rough sets, *International Journal of Computer and Information Sciences* **11** (1982), 341–356.
[2] L. Zadeh, Fuzzy sets, *Information and Control* **8** (1965), 338–353.
[3] International Rough Set Society (IRSS), http://www.roughsets.org/.