Granular Computing
https://doi.org/10.1007/s41066-018-00146-2

PREFACE

Granular computing in machine learning

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Granular computing (GrC), its main idea coming from Zadeh's fuzzy information granulation, plays a fundamental role in human reasoning and problem solving. The three basic issues in the theory of GrC are information granulation, organization and causation. Specifically, information granulation involves the decomposition of a whole into parts, the organization involves integration of parts into a whole, and the causation involves the association of causes with effects. They have been applied to many fields such as machine learning, data mining and knowledge discovery.

In machine learning, data pre-processing has been shown to be an effective way of improving learning accuracy or efficiency. Since GrC is a useful mathematical tool for data pre-processing, it is natural for researchers to incorporate GrC into the study of machine learning.

In recent years, we have witnessed a rapid growing interest in GrC viewed as a new asset of studies of machine learning. Especially, for some certain types of machine learning problems, we indeed observed that data pre-processing via information granulation or combining GrC technique with machine learning method can improve learning accuracy or efficiency sharply, such as GrC-based feature selection, GrC-based classification algorithm, concept-cognitive learning with GrC, cost-sensitive active learning via GrC, and multi-granulation learning in cognition. However, to the best of our knowledge, the studies on machine learning problems in big data environment with the aid of GrC are very limited.

This special issue offers a snapshot of new theories, methods, and algorithms to effectively support GrC-based machine learning for big data. It is composed of eight papers. A brief summary of them is given as follows.

In the first paper entitled "Neighborhood attribute reduction for imbalanced data", Wendong Zhang, Xun Wang, Xibei Yang, Xiangjian Chen, and Pingxin Wang construct the attribute reduction strategy in imbalanced data for improving the classification performance based on neighborhood decision error rate.

The paper entitled "Attribute reduction based on the Boolean matrix", written by Yunpeng Shi, Yang Huang, Changzhong Wang, and Qiang He, proposes a forward greedy attribute reduction algorithm based on Boolean logic. The main contribution is to introduce Boolean logic into neighborhood rough set models.

Meishe Liang, Jusheng Mi, and Tao Feng put forward an optimal granulation selection algorithm for a multi-granulation and multi-label decision table in their paper entitled "Optimal granulation selection for multi-label data based on multi-granulation rough sets". The obtained results can benefit the multi-granulation rough set (MGRS)-based approach for multi-label data.

In the fourth paper entitled "Granule description based on positive and negative attributes", Huilai Zhi and Jinhai Li try to reduce computational complexity for granule description by avoiding the construction of concept lattices. The main contribution of this work is to find the most concise descriptions of definable granules from the perspectives of positive and negative attributes.

The paper entitled "Multi-level granularity in formal concept analysis", written by Jianjun Qi, Ling Wei, and Qing Wan, combines formal concept analysis (FCA) with granular computing to promote the study of multi-level granularity in FCA by means of presenting some specific granules.

In the sixth paper entitled "Three-way decisions with reflexive probabilistic rough fuzzy sets", Jianmin Ma, Hongying Zhang, and Yuhua Qian discuss three-way decisions by the lower and upper reflexive probabilistic rough fuzzy approximations based on a pair of thresholds and a level value.

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Published online: 23 November 2018

Qingzhao Kong, Xiawei Zhang and Weihua Xu develop the operation theory of multi-covering rough sets (MCRSs) and explore the algebraic properties of MCRSs in their paper entitled "Operation properties and algebraic properties of multi-covering rough sets".

The last paper entitled "Probabilistic decision making based on rough sets in interval-valued fuzzy information systems", written by Derong Shi and Xiaoyan Zhang, tries to make probabilistic decision under the environment of interval-valued fuzzy information systems. The main contribution of this work is to explore two kinds of probability decision-theoretic rough set methods by combining the Bayesian decision process.

We hope that this special issue can offer some useful references for those who are interested in new advances in combining GrC and machine learning, and particularly for those who are trying to establish effective GrC-based machine learning models for big data.

The Guest Editors thank all the authors for submitting their high-quality papers, all the reviewers for their constructive comments to further enhance the quality of the papers, and Prof. W. Pedrycz and Prof. S.-M. Chen, Editors-in-Chief of Granular Computing, for their great support in the organization of this special issue.

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