EDITORIAL

Three-way decisions, concept lattice and granular computing: Editorial

Xizhao Wang[1] · Jinhai Li[2]

Three-way decisions (3WD) were proposed by Yiyu Yao in 2009 as a means to solve all kinds of ternary classification problems. Concept lattice is the basic data analysis tool in formal concept analysis (FCA) which was presented by Rudolf Wille in 1982. The term of granular computing (GrC) was given by Tsau Young Lin in 1997, but the main idea of granular computing was from Lotfi A. Zadeh's fuzzy information granulation. Witold Pedrycz and Yiyu Yao put forward some basic problems and research topics of granular computing. To the best of our knowledge, the idea of information granulation is the common characteristic among three-way decisions, concept lattice and granular computing, and from the viewpoint of information granulation, these three theories have been compared with or related to one another. Recently, three-way decisions, concept lattice and granular computing have also been combined to achieve complex data analysis tasks or establish machine learning models.

As far as we know, some preliminary results have been obtained in comparing, connecting and combining three-way decisions, concept lattice and granular computing, such as fuzzy three-way concept analysis, sequential three-way concept learning, multi-source concept granular computing model, information-fusion-based multi-granulation concept learning, and so on. These preliminary achievements have abstracted much attention from the communities of rough set, data mining, knowledge discovery, machine learning, etc.

This issue is constituted by 12 papers. It offers a snapshot of new theories, methods, and algorithms in comparing, connecting and combining three-way decisions, concept lattice and granular computing. A brief summary of the selected 12 papers is given as follows.

In the first paper entitled "An analysis of three types of partially-known formal concepts", Ruisi Ren, Ling Wei and Yiyu Yao thoroughly investigate the structures and relationships among three different forms of partially-known formal concepts under the environment of incomplete data based on interval set theory.

Jiaojiao Niu, Chenchen Huang, Jinhai Li and Min Fan explore some parallel computing techniques for concept-cognitive learning (CCL) in terms of large data and multi-source data based on granular computing. The main purpose of their paper entitled "Parallel computing techniques for concept-cognitive learning based on granular computing" is to extract global granular concepts by combining local granular concepts using the divide-and-conquer strategy.

The paper entitled "Role based access control design using three-way formal concept analysis", written by Chandra Mouliswaran Subramanian, Aswani Kumar Cherukuri and Chandrasekar Chelliah, applies three-way formal concept analysis on role based access control (RBAC) and evaluates the performance of the new method.

In the fourth paper entitled "Three-way n-valued neutrosophic concept lattice at different granulation", Prem Kumar Singh puts forward the notions of n-valued neutrosophic context and n-valued neutrosophic concept, and analyzes their decomposition with the help of granular computing.

Xiaoli He, Ling Wei and Yanhong She introduce fuzzy logic into three-way formal concept analysis in their paper entitled "L-fuzzy concept analysis for three-way decisions: basic definitions and fuzzy inference mechanisms". The main contribution of their work lies in fuzzy inference based on L-fuzzy three-way concept lattice.

The paper entitled "Connections between two-universe rough sets and formal concepts", written by Mingwen Shao, Li Guo and Changzhong Wang, discusses the relationships

✉ Xizhao Wang
   xizhaowang@ieee.org

   Jinhai Li
   jhlixjtu@163.com

[1] College of Computer Science and Software Engineering, Shenzhen University, Shenzhen 518060, People's Republic of China

[2] Faculty of Science, Kunming University of Science and Technology, Kunming 650500, Yunnan, People's Republic of China

between two-universe rough sets and the object (attribute) oriented formal concepts.

In the seventh paper entitled "A new FCA-based method for identifying biclusters in gene expression data", Amina Houari, Wassim Ayadi and Sadok Ben Yahia use formal concept analysis to extract the set of biclusters from gene expression data, and show the effectiveness by some experiments.

Xiangping Kang, Duoqian Miao, Guoping Lin and Yong Liu convert complex information systems into relatively simple ones by means of granulation of relation in their paper entitled "Relation granulation and algebraic structure based on concept lattice in complex information systems". The main objective of this paper is to combine rough set and concept lattice from the perspective of relation granulation.

The paper entitled "Fuzzy decision implication canonical basis", written by Yanhui Zhai, Deyu Li and Kaishe Qu, reduces the number of fuzzy decision implications by computing the so-called fuzzy decision implication canonical basis.

In the tenth paper entitled "Synthesizing decision rules from multiple information sources: a neighborhood granulation viewpoint", Yaojin Lin, Huihuang Chen, Guoping Lin, Jinkun Chen, Zhouming Ma and Jinjin Li extract local decision rules at different local information sources, and further fusion these local rules to generate global ones. The key strategy adopted in this paper is based on the neighborhood granulation of each sample.

Changzhong Wang, Qiang He, Mingwen Shao and Qinghua Hu study feature selection subject to maintaining the maximal dependency and greatest discernibility ability in their paper entitled "Feature selection based on maximal neighborhood discernibility".

The final paper entitled "Decision-theoretic rough set model of multi-source decision systems", written by Binbin Sang, Yanting Guo, Derong Shi and Weihua Xu, introduces three different types of multi-source decision methods based on different information fusion strategies.

In a word, we hope that this issue offers some useful references for those who are interested in new advances in comparing, connecting and combining three-way decisions, concept lattice and granular computing, and particularly for those who are trying to achieve complex data analysis tasks or establish machine learning models based on 3WD, FCA and GrC.