Data-Driven Granular Computing Systems and Applications

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Granular Computing (GrC), as a framework for data/information processing, is an umbrella term that encompasses a breadth of Soft Computing methods. Focusing on Machine Learning and Artificial Intelligence, we have experienced significant research growth in the direct use of data/information in order to computationally learn how systems behave, perform, evolve and in general capture information in the form of mathematical structures (models). Granular Computing has a significant role to play in the development of data-driven Machine Learning methods, in particular when human centricity is important. Desired traits include high levels of system interpretability, direct use of human expert knowledge, use of human-like information capture, as well as elicitation of linguistic-based rules.

In this special issue, we have invited submissions that demonstrate data-driven development of Granular Computing methods, algorithms and systems, as well as applications. Based on the recommendations made by independent referees, eight high-quality papers were accepted for this special issue on Data-Driven Granular Computing Systems and Applications.

Yunlong Cheng, Fan Zhao, Qinghua Zhang and Guoyin Wang contribute a paper *A Survey on Granular Computing and Its Uncertainty Measure from the Perspective of Rough Set Theory*. In this article, the authors review the literature

of uncertainty measures within Granular Computing, with a focus on rough sets, and provide a summary of basic principles as well as applications. Yuji Yoshida discusses a dynamic risk-sensitive portfolio optimization problem under risk constraints with the use of coherent risk measures and fuzzy random variables in the paper *Dynamic Risk-Sensitive Fuzzy Asset Management with Coherent Risk Measures Derived from Decision Maker's Utility*; numerical examples are included to demonstrate the significance of the obtained results.

Shu Zhao et. al discuss on how to capture the adaptive hierarchical structure of a network system (community detection) and propose a variable granularity method to construct the hierarchical structure based on quotient space theory. Their paper entitled *VGHC: A variable granularity hierarchical clustering for community detection* includes experimental studies on seven real-world networks that demonstrate the effectiveness of the proposed method for community detection in networks compared to the effectiveness of the current state-of-the-art algorithms. Ivo Düntsch et.al present *Measures and approximations using empirical structures* that demonstrates the process of analyzing data based on observed granules according to a model proposed by G. Gigerenzer; the authors argue the necessity of coping with an error approximation framework when trying to link a theoretical model to empirical data.

Subsequently, Shu Zhao et al. present their work on *A Multi-Granular Network Representation Learning Method* which introduces Quotient Space Theory, one of Granular Computing theories into network embedding, and propose a Multi-Granular Network Representation Learning method. The proposed method is designed to preserve both global and local structures at different levels of granularity. M. Priya and Ch. Aswani Kumar propose an approach to merge domain ontologies using Granular Computing in their paper *An Approach to Merge Domain Ontologies using Granular Computing*. The paper employs Granular Computing as a framework for merging the existing domain ontologies thereby unifying multiple domain ontologies into a single representative domain ontology.

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In recent years, overlapping community detection, especially in real-world social networks, has become an important and challenging research area since it introduces the possibility of membership of a vertex in more than a single community. Kushagra Trivedi and Sheela Ramanna propose a hybrid computational geometry approach with Voronoi diagrams and the use of tolerance-based neighborhoods to detect overlapping communities in social networks in the paper *Overlapping Community Detection in Social Networks with Voronoi and Tolerance neighbourhood-based method*. This special issue is concluded by a contribution by Gong Cheng, Qingfeng Chen and Ruchang Zhang. The authors discuss about predicting phosphorylation sites, a data-driven challenge that includes large amount of data. The proposed method first maps the raw data into a high-dimensional kernel space and then divides them by clustering to obtain high-dimensional equilibrium grains. The paper is entitled as *Prediction of Phosphorylation Sites Based on Granular Support Vector Machine*.

We hope that this special issue will provide a reference for researchers in the area of Granular Computing, with focus on data-driven systems and applications. The presented work by the contributing to this issue authors not only clearly provides examples of the impact that Granular Computing has on data-driven systems, but also yields interesting conclusions for further research.

The Guest Editors would like to thank all the authors for submitting their papers to the special issue. We thank all reviewers who carried out the most important work by rigorously evaluating the submitted papers. We also thank Professor Witold Pedrycz and Professor Shyi-Ming Chen, the Editors-in-Chief of Granular Computing, for helping us in the organization of this special issue as well as their technical support.

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