Guest Editorial Special Issue on Computational Intelligence in Big Graph Data Management

BIG GRAPH Data Management (BGDM) has been significant in lots of areas, like biology, transportation, medical science, and physics, etc. BGDM has been widely used in, for example, route planning in transportation graphs, expert finding in social graphs, and DNA structure identification in protein graphs. In these applications, due to the largescale of big graph data, the complex attributes included in big graphs, and the dynamic changes of big graph structures, the requirements for the computational intelligence in graph data management are becoming more and more demanding. For example, the effective graph embedding techniques for high dimensional big graph data, the prediction of graph structures in dynamic big graphs, the deep learning-based trust, security, and privacy management in big graph data, the intelligent distributed and parallel algorithms for big graph data search. The Computational Intelligence related techniques, like the deep learning and the neural networks are becoming core methods and effective ways of addressing the challenges in big data management. Therefore, it is necessary to develop mechanisms with adopting computation intelligence in big graph data management, which builds up a secure, effective, and efficient environment for the BGDM, further supporting graph data based applications as a backbone.

This special issue focuses on emerging computational intelligence (CI) based theories and methodologies for big graph data management. The emerging CI techniques cover a broad range of nature-inspired, multidisciplinary computational methodologies, such as fuzzy logic, graph pattern matching, graph neural networks, graph embedding, graph attention, evolutionary computing, cognitive computing, learning theory, and probabilistic methods. The objective of this special issue is to explore how CI models and their variants can be adapted, augmented and extended to deal with applications involving very large scale graph data.

Keeping the above objectives in mind, we have selected five articles for this special issue of the IEEE Transactions on Emerging Topics in Computational Intelligence, that represents some of the latest developments in the emerging areas of computational intelligence techniques for big graph data management. For the record, a total of fourteen submissions were received in response to the open call. These papers were rigorously evaluated according to the normal reviewing process, which took into consideration factors pertaining to originality, technical quality, presentation, and overall contribution. Five articles were accepted. The breadth of the research captured by these articles provides an indication of the importance of theories and methodologies for computational intelligence techniques in big graph data management.

The paper titled "Optimal Searching Time Allocation for Information Collection Under Cooperative Path Planning of Multiple UAVs," by Yanmin et al., proposes a novel Adaptive Path and Time Schedule Procedure (APTSP) which considers the paths and time distribution simultaneously. The model introduces a new Perturbed Parametric Nonlinear Complementarity Problem function (PPNCP-function), which reformulates the time allocation problem as a smoothing system of equations. The experimental results have demonstrated the effectiveness and efficiency of the proposed model in solving the information searching problem.

The paper titled "Compactness Preserving Community Computation Via a Network Generative Process," by Jie et al., develops a new metric named fuzzy compactness to measure a fuzzy community structure's significance, based on which, the paper proposes FCOCD-an effective approach with fuzzy compactness optimization for overlapping community detection in social networks. Experimental results illustrate the good performance of the proposed method in terms of the detection accuracy and the scalability.

The third paper titled "Interval-Valued Intuitionistic Fuzzy Decision with Graph Pattern in Big Graph," by Lei et al., proposes a new interval-valued intuitionistic fuzzy decision (IVIFD) model with graph pattern in big graphs. In the model, the graph pattern matching is adopted to prune the searching space, which makes it possible to process IVIFD under the preference of the decision maker later. The experimental results illustrate the effectiveness and stability of the proposed method in expressing fuzziness, uncertainty and hesitancy in real-world decision making problems.

The paper titled "Wavefront based Multiple Rumor Sources Identification by Multi-Task Learning," by Ming et al., proposes a sequence-to-sequence model, called Graph Constraint based Sequential Source Identification (GCSSI), which takes wavefront as input to solve the multiple rumor source detection (MRSD) problem. By adopting encoder-decoder structure and graph constraint based multi-task learning, GCSSI estimates the reverse rumor dissemination at each time step and predicts sources in an end-to-end way. The experiments experimental

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results illustrate the superiority of the proposed model in identifying rumor sources in social networks.

The last paper titled "Attraction and Repulsion: Unsupervised Domain Adaptive Graph Contrastive Learning Network," by Man et al., proposes a novel Graph Contrastive Learning Network (GCLN) for unsupervised domain adaptive graph learning. The key innovation is to enforce attraction and repulsion forces within each single graph domain, as well as across two graph domains. The within- and cross-domain graph contrastive learning is carried out by optimizing an objective function, which combines source classifier loss, domain classifier loss, target classifier loss, domain-specific contrastive loss, and cross-domain contrastive loss. As a result, feature learning from graphs are facilitated using knowledge transferred between graphs. The experiments have demonstrated that the proposed method outperforms state-of-the-art graph neural network algorithms.

In summary, five selected papers for this special issue highlight a subset of the challenging and novel applications of emerging computational intelligence theories and methodologies for big graph data management. The guest editors would like to thank all the authors who submitted their work to the special issue, and all reviewers for their hard work in completing timely and constructive reviews. Special thanks go to the Editor-in-Chief, Prof Yew-Soon Ong, and members of the editorial team for their support during the editing process of this Special Issue. They worked closely with the guest editors to ensure excellent quality of this issue and guarantee its success.

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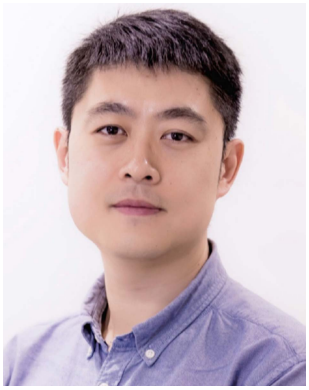

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