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Knowledge Science, Engineering and Management

16th International Conference, KSEM 2023
Guangzhou, China, August 16–18, 2023
Proceedings, Part IV

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Preface

We are extremely pleased to introduce the Proceedings of the 16th International Conference on Knowledge Science, Engineering and Management (KSEM 2023), this is a four-volume set containing the papers accepted for this year's conference, which was organized by and hosted at the South China Normal University, Guangzhou, China during August 16–18, 2023.

Since its inaugural conference back in 2006, KSEM has accumulated great success under the immense efforts from each year's organizing committee and beyond. Previous years' events were held in Guilin, China (KSEM 2006); Melbourne, Australia (KSEM 2007); Vienna, Austria (KSEM 2009); Belfast, UK (KSEM 2010); Irvine, USA (KSEM 2011), Dalian, China (KSEM 2013); Sibiu, Romania (KSEM 2014); Chongqing, China (KSEM 2015); Passau, Germany (KSEM 2016); Melbourne, Australia (KSEM 2017); Changchun, China (KSEM 2018); Athens, Greece (KSEM 2019). Even during the COVID pandemic, KSEM was continued and held in Hangzhou, China (KSEM 2020); Tokyo, Japan (KSEM 2021) and Singapore (KSEM 2022), respectively.

The objective of KSEM is to create a forum that gathers researchers and practitioners from academia, industry, and government around the globe to present advancements in theories and state-of-the-art technologies in the field of knowledge science, engineering, and management. Attendees were encouraged to present prototypes and deploy knowledge-based systems, discuss and debate practical challenges as well as opportunities for the research community. With its interdisciplinary nature, KSEM 2023 focused on four broad areas: Knowledge Science with Learning and AI (KSLA), Knowledge Engineering Research and Applications (KERA), Knowledge Management Systems (KMS), and Emerging Technologies for Knowledge Science, Engineering and Management (ETKS).

In this year's conference, we received 395 submissions. Single-blind review was adopted for the conference review process. Each submission was peer reviewed by 2 to 4 reviewers from the program committee members and external reviewers. Among them, 114 regular papers (28.8% acceptance rate) and 30 short papers were selected, giving a total of 144 papers. We have separated the proceedings into four volumes: LNCS 14117, 14118, 14119, and 14120. The collection of papers represents a wide range of research activities, covering knowledge representation and reasoning, knowledge extraction, knowledge integration, data mining and knowledge discovery, and beyond.

In addition to the regular sessions, this year's event featured the following keynote speakers:

- Witold Pedrycz, University of Alberta, Canada, with the presentation titled *Credibility of Machine Learning Through Information Granularity*;
- Zhi-Hua Zhou, Nanjing University, China, with the presentation titled *A New Paradigm to Leverage Formalized Knowledge and Machine Learning*;

- Geoff Webb, Monash University, Australia, with the presentation titled *Recent Advances in Assessing Time Series Similarity Through Dynamic Time Warping*;
- Jie Tang, Tsinghua University, China, with the presentation titled *ChatGLM: Run Your Own "ChatGPT" on a Laptop.*

We would like to express our sincere gratitude to the many contributors who were steadfast supporters and made KSEM 2023 a great success. First of all, we would like to thank the KSEM 2023 Organizing Committee, the School of Computer Science at South China Normal University, Sun Yat-sen University, and our publisher Springer, without their crucial support the conference would not have been possible. Secondly, we would like to thank the members of our Steering Committee (Honorary General Chairs), Ruqian Lu from the Chinese Academy of Sciences, and Dimitris Karagiannis from the University of Vienna, Austria, for their invaluable guidance throughout the event; the General Co-chairs, Zhi Jin from Peking University, Christos Douligeris from the University of Piraeus, Daniel Neagu from the University of Bradford, and Weihua Ma from South China Normal University. They were involved in the whole process of the organization efforts, and provided various critical resources, including but not limited to connections to external reviewers and professional advice. Last but not least, we would like to thank the authors who submitted their papers to this year's conference, the Program Committee and the external reviewers, without whom the daunting tasks of paper reviews would not have been accomplished in time.

We hope that the reader finds the results of the conference program valuable and thought-provoking, and we hope attendees had a valuable opportunity to share ideas with other researchers and practitioners from institutions around the world.

August 2023

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Yuncheng Jiang
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Keynotes Abstracts

Credibility of Machine Learning Through Information Granularity

Witold Pedrycz

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Abstract. Over the recent years, we have been witnessing numerous and far-reaching developments and applications of Machine Learning (ML). Efficient and systematic design of their architectures is important. Equally important are comprehensive evaluation mechanisms aimed at the assessment of the quality of the obtained results. The credibility of ML models is also of concern to any application, especially the one exhibiting a high level of criticality commonly encountered in autonomous systems and critical processes of decision-making. With this regard, there are a number of burning questions: how to quantify the quality of a result produced by the ML model? What is its credibility? How to equip the models with some self-awareness mechanism so careful guidance for additional supportive experimental evidence could be triggered?

Proceeding with a conceptual and algorithmic pursuits, we advocate that these problems could be formalized in the settings of Granular Computing (GrC). We show that any numeric result be augmented by the associated information granules being viewed as an essential vehicle to quantify credibility. A number of key formalisms explored in GrC are explored, namely those involving probabilistic, interval, and fuzzy information granules. Depending on the formal settings, confidence levels and confidence intervals or coverage and specificity criteria are discussed in depth and we show their role as descriptors of credibility measures.

The general proposals of granular embedding and granular Gaussian Process models are discussed along with their ensemble architectures. In the sequel, several representative and direct applications arising in the realm of transfer learning, knowledge distillation, and federated learning are discussed.

A New Paradigm to Leverage Formalized Knowledge and Machine Learning

Zhi-Hua Zhou

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Abstract. To develop a unified framework which accommodates and enables machine learning and logical knowledge reasoning to work together effectively is a well-known holy grail problem in artificial intelligence. It is often claimed that advanced intelligent technologies can emerge when machine learning and logical knowledge reasoning can be seamlessly integrated as human beings generally perform problem-solving based on the leverage of perception and reasoning, where perception corresponds to a data-driven process that can be realized by machine learning whereas reasoning corresponds to a knowledge-driven process that can be realized by formalized reasoning. This talk ill present a recent study in this line.

Recent Advances in Assessing Time Series Similarity Through Dynamic Time Warping

Geoff Webb

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Abstract. Time series are a ubiquitous data type that capture information as it evolves over time. Dynamic Time Warping is the classic technique for quantifying similarity between time series. This talk outlines our impactful program of research that has transformed the state of the art in practical application of Dynamic Time Warping to big data tasks. These include fast and effective lower bounds, fast dynamic programming methods for calculating Dynamic Time Warping, and intuitive and effective variants of Dynamic Time Warping that moderate its sometimes-excessive flexibility.

ChatGLM: Run Your Own "ChatGPT" on a Laptop

Jie Tang

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Abstract. Large language models have substantially advanced the state of the art in various AI tasks, such as natural language understanding and text generation, and image processing, multimodal modeling. In this talk, I am going to talk about how we build GLM-130B, a bilingual (English and Chinese) pre-trained language model with 130 billion parameters. It is an attempt to open-source a 100B-scale model at least as good as GPT-3 and unveil how models of such a scale can be successfully pre-trained. Based on GLM-130B, we have developed ChatGLM, an alternative to ChatGPT. A small version, ChatGLM-6B, is opened with weights and codes. It can be deployed with one RTX 2080 Ti (11G) GPU, which makes it possible for everyone to deploy a ChatGPT! It has attracted over 2,000,000 downloads on Hugging Face in one month, and won the trending #1 model for two weeks.

GLM-130B: https://github.com/THUDM/GLM-130B.
ChatGLM: https://github.com/THUDM/ChatGLM-6B.

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