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Special issue on conceptual structures

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1 Preface

This special issue collects fully revised and extended versions of selected contributions presented at the International Conference on Conceptual Structures (ICCS 2020), "Ontologies and Concepts in Mind and Machines" [1], which was held online on September 18-21, 2020.

The ICCS conference focuses on the formal analysis and representation of conceptual knowledge, at the crossroads of artificial intelligence, human cognition, computational linguistics, and related areas of computer science and cognitive science. Recently, graph based Knowledge Representation and Reasoning (KRR) paradigms are getting more and more attention. With the rise of quasi-autonomous Artificial Intelligence (AI), graph-based representations provide a vehicle for making machine cognition explicit to its human users. Conversely, graphical and graph-based models can provide a rigorous way of expressing intuitive notions in computable frameworks. The aim of the ICCS 2020 conference is to build upon its long-standing expertise in graph-based KRR and focus on providing modeling, formal, and application results of graph-based systems. The special issue welcomes contributions from a modeling, application, and theoretical viewpoint.

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2 Aims

The aim of the conference was to attract submissions within 5 major areas:

1. **Graph representations and analysis**, for example, existential and conceptual graphs, graph-based models for human reasoning, social networks, and formal concept analysis. It also includes philosophical, neural, and didactic investigations of conceptual, graphical representations.
2. **Conceptual knowledge acquisition**, including data and text mining beliefs, uncertainty, and inconsistency.
3. **Human and machine reasoning under inconsistency** as well as automated decision-making and argumentation, preferences and knowledge engineering.
4. **Contextual logic** including ontologies, knowledge architecture and management, as well as topics involving Semantic Web, Web of Data, Web 2.0, natural language processing and linguistics.
5. **Constraint Satisfaction and Optimisation** including resource allocation and agreement technologies.

3 Content

After the conference, the authors of the accepted papers were invited to prepare thoroughly revised and extended versions of their contributions for inclusion in this special issue. There were 10 submissions for this special issue out of which 6 submissions were accepted. A brief summary of the six accepted papers is provided below.

The first paper "*Computing Triadic Generators and Association Rules from Triadic Contexts*" by Rokia Missaoui, Pedro H. B. Ruas, Leonard Kwuida, Mark A. J. Song, and Mohamed Hamza Ibrahim proposes a set of algorithms that displays a Hasse diagram of triadic concepts in Triadic Concept Analysis and compute triadic generators and association rules, including implications without any need for a pre-processing step to convert the triadic representation into a dyadic one.

The second paper "*On Pruning Techniques in Map-Reduce Style CbO Algorithms*" by Jan Konecny and Petr Krajca proposes four new CbO- based algorithms based on Apache Spark or other such frameworks. It also shows that the pruning strategy can be incorporated into these algorithms. The authors experimentally evaluate the impact of the pruning and demonstrate the scalability of the new algorithms.

The third paper "*A Semiotic Perspective on Polysemy*" by Uta Priss extends Semiotic-Conceptual Analysis (SCA) to provide a means for comparing and evaluating semiotic relations (i.e. sets of signs) with respect to their ability and efficiency of expressing conceptual structures.

The fourth paper "*Indepth combinatorial analysis of admissible sets for abstract argumentation*" by Cosmina Croitoru and Madalina Croitoru investigates from a graph theoretical point of view, the notion of acceptability in Dung semantics for abstract argumentation frameworks. The authors introduce and analyze combinatorial structures exploited for taming, in particular cases, the exponential blowout of acceptance algorithms.

The fifth paper "*Learning with Cone-Based Geometric Models and Orthologics*" by Mena Leemhuis, Ozgur L. Ozcep, and Diedrich Wolter proposes a new approach to embedding ontologies into geometric models that interpret concepts by geometrical structures based on convex cones. The ontologies are assumed to be represented in an orthologic, a logic with a full (ortho)negation. As a proof of concept, this cone-based embedding was implemented within two ML algorithms for weak supervised multi-label learning. Both algorithms rely on cones but the first addresses ontologies expressed in classical propositional logic whereas the second addresses a weaker propositional logic, namely a weak orthologic that does not fulfill distributivity.

The sixth paper "*On Shapley Value Interpretability in Concept-Based Learning with Formal Concept Analysis*" by Dmitry I. Ignatov and Leonard Kwuida proposes the usage of two power indices from cooperative game theory and public choice theory for ranking attributes of closed sets, namely intents of formal concepts (or closed itemsets). The introduced indices are related to extensional concept stability and are also based on the counting of generators, especially those that contain a selected attribute.

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Simon Andrews	Aleksey Buzmakov	Diana Cristea
Licong Cui	Wolfgang Dvorak	Bernhard Ganter
Tom Hanika	Marianne Huchard	Léonard Kwuida
Rokia Missaoui	Amedeo Napoli	Sergei Obiedkov
Matthias Thimm	Markus Ulbricht	

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Data Availability This article has no associated data since it is a brief summary of the articles accepted in the Special Issue on Conceptual Structures.

Declarations

Conflict of Interests We have no conflicts or competing interests to declare.

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