Selected papers from the First International Joint Conference on Conceptual Knowledge Structures

The First International Joint Conference on Conceptual Knowledge Structures (CONCEPTS 2024) is a merger of three conferences that have been essential venues for researchers and practitioners working on theoretical and applied aspects of formal concept analysis and representation of conceptual knowledge, as well as closely related areas, such as data mining, information retrieval, knowledge management and discovery:

- 28th International Conference on Conceptual Structures (ICCS)

- 18th International Conference on Formal Concept Analysis (ICFCA)

- 17th International Conference on Concept Lattices and their Applications (CLA)

The event took place in Cádiz, Spain, from September 9 to September 13, 2024. This new conference aims to continue the tradition and standards of the previous conferences and become a key annual meeting to take along all members of the three communities of CLA, ICCS, and ICFCA and to keep abreast of the advances and new challenges in the field.

Submissions of significant and original research were invited on topics relevant to the conference. They were subject to single-blind peer review by following three different modalities: journal-track papers, regular papers, and short papers. Additionally, extended abstracts of papers that had already been published within the past two years were accepted for presentation at the conference.

A total of eleven journal-track papers, twenty-nine regular papers, nine short papers, and fourteen extended abstracts were submitted by authors from around the world, underscoring the global interest in conceptual structures. Each submission underwent a rigorous review process. Ultimately, eighteen regular papers and four short papers were accepted and published in the conference proceedings [1]. In addition, six journal-track papers were accepted and are featured in this special issue of the *International Journal of Approximate Reasoning*:

- *Aggregation of fuzzy graphs* by Francisco Javier Talavera, Carlos Bejines, Sergio Ardanza-Trevijano, and Jorge Elorza [2] advances the understanding of aggregation processes in fuzzy graph structures, with important implications for fuzzy concept analysis and decision-making. The authors examine the role of aggregation operators in preserving various properties of fuzzy graphs and offer criteria for maintaining completeness within these structures.

- *Arrow relations in lattices of integer partitions* by Asma'a Almazaydeh, Mike Behrisch, Edith Vargas-García, and Andreas Wachtel [3] solves an open question, attributed to Bernhard Ganter, concerning the single and double arrow relations of the standard context of the lattice of partitions of any positive integer under the dominance order.

- *Bimorphisms and attribute implications in heterogeneous formal contexts* by L'ubomír Antoni, Peter Eliaš, Ján Guniš, Dominika Kotlárová, Stanislav Krajči, Ondrej Krídlo, Pavol Sokol, and L'ubomír Šnajder [4] presents theoretical advancements in the study of heterogeneous formal contexts. The paper includes equivalent definitions of concept-forming operators, bimorphisms, and heterogeneous attribute implications. By incorporating heterogeneity into formal concept analysis, the authors expand its practical applicability, demonstrated through case studies from diverse fields, such as privacy and cybersecurity.

- *Exploring the 3-dimensional variability of websites' user-stories using triadic concept analysis* by Alexandre Bazin, Thomas Georges, Marianne Huchard, Pierre Martin, and Chouki Tibermacine [5] introduces a framework for analyzing variability in families of similar software systems across three dimensions: software, roles, and features. The authors employ triadic concept analysis to derive three-dimensional implications from user-stories that capture software requirements.

- *Semantic explorations in factorizing Boolean data via formal concepts* by Radim Belohlavek and Martin Trnecka [6] presents an experimental study exploring the semantic aspects of Boolean matrix factorization, based on the Dutch data—psychological data involving human concepts, objects covered by these concepts, binary attributes for object description, and Boolean matrices describing the objects with these attributes. The authors focus on the GreConD algorithm, which utilizes formal concepts to build factors, demonstrating its ability to retrieve human categories inherently present in the data.

- *Description lattices of generalised convex hulls* by Christophe Demko, Karell Bertet, Jean-François Viaud, Cyril Faucher, and Damien Mondou [7] presents a new approach to lattice generation from complex and heterogeneous data, involving the concept of convexity. By using a formalism based on the properties of closure operators, the essential properties of the description spaces are revisited. The effectiveness of employing generalised convex hulls compared to pattern structures, widely used in formal concept analysis, is investigated.

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We would like to conclude by acknowledging the support and confidence of Elsevier in publishing this special issue. We are grateful Prof. Denoeux, Editor-in-Chief of the journal, for his help and generosity throughout the review and decision-making process, and for his support in final decisions that were not always easy.

References

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