



Preface

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This special issue of the *Annals of Mathematics and Artificial Intelligence* contains thoroughly revised and significantly extended versions of selected papers presented at the Twelfth International Symposium on Foundations of Information and Knowledge Systems (FoIKS 2022), which was held at the University of Helsinki, Finland, June 20–23, 2022.

The FoIKS symposia provide a biennial forum for presenting and discussing theoretical and applied research on information and knowledge systems. The goal is to bring together researchers with an interest in this subject, share research experiences, promote collaboration, and identify new issues and directions for future research.

Previous FoIKS meetings were held in Schloss Salzau (Germany, 2002), Vienna (Austria, 2004), Budapest (Hungary, 2006), Pisa (Italy, 2008), Sofia (Bulgaria, 2010), Kiel (Germany, 2012), Bordeaux (France, 2014), Linz (Austria, 2016), Budapest (Hungary, 2018), and Dortmund (Germany, 2020).

The call for papers solicited original contributions dealing with any foundational aspect of information and knowledge systems, including submissions that apply ideas, theories, or methods from specific disciplines to information and knowledge systems. Examples of such disciplines are discrete mathematics, logic and algebra, model theory, databases, information theory, complexity theory, algorithmics and computation, statistics, and optimization. Traditionally, the FoIKS symposia are a forum for intensive discussion where speakers are given sufficient time to present their ideas and results within the larger context of their research. Furthermore, participants are asked to prepare a first response to another contribution in order to initiate discussion.

FoIKS 2022 received 21 submissions, which were evaluated by the Program Committee on the basis of their significance, novelty, technical soundness, and appropriateness for the FoIKS audience. Each paper was subjected to three reviews (two reviews in only one case). In the end, 13 papers were selected for oral presentation at the symposium and publication in the archival proceedings.

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The authors of these 13 papers were invited to submit a thoroughly revised and substantially extended version of their symposium paper for this special issue of the Annals of Mathematics and Artificial Intelligence. Five papers were submitted and rigorously reviewed over several rounds of revisions, each by two or three international experts in the domain of the paper. All five were finally accepted:

- Many different approaches have been suggested for drawing inferences from conditional belief bases. In *Reasoning with System W and infeasible worlds*, Jonas Haldiman, Christoph Beierle, Gabriele Kern-Isberner, and Thomas Meyer focus on the inference operator system W, which has already been shown previously to possess interesting properties. In this paper, the authors show that System W satisfies syntax splitting. Unfortunately, System W, as it was set up, only considers inference from belief bases satisfying a strong notion of consistency. The authors extend System W so that inferences from belief bases that only satisfy a weaker notion of consistency are covered. They study this Extended System W, and show that it still complies with syntax splitting while retaining the desirable properties of System W.

- In *On domain generators for the evaluation of action reversibility in STRIPS*, Tobias Schwartz, Jan H. Boockmann, and Leon Martin consider the evaluation of action reversibility in STRIPS planning. The authors are motivated by the fact that action reversibility contributes to achieving robust plans, and that robustness is a crucial requirement for the deployment of AI systems in real-world scenarios. The paper considers variations on the existing domain generator. Their experiments show that these new domain generators can produce a variety of domains with diverse search space characteristics, enabling a less biased evaluation of action reversibility systems.

- Many modern-day systems rely on information that is constantly arriving, and they need to make decisions based on it. In many situations, these systems can benefit from identifying possible outcomes that are consistent with the data available so far. Such scenarios are called hypothetical answers, and previous work has defined them precisely and shown how they can be updated in step with the arrival of additional input. In *Can't you answer while you wait?*, Luís Cruz-Filipe, Graça Gaspar, and Isabel Nunes argue that the current assumption that data always arrives instantaneously is not realistic. They develop a more general framework that supports communication delays, and use fixpoint theory to address the challenges that arise from this relaxation. The authors show that the relevant fixpoints can be computed in finite time by a carefully designed algorithm.

- A strongly possible constraint is an intermediate concept between possible and certain constraints, based on the strongly possible world approach (a strongly possible world is obtained by replacing nulls by a value from the ones appearing in the corresponding attribute of the table). In *Approximate integrity constraints in incomplete databases with limited domains*, Attila Sali and Al-Atar Munqath introduce and study strongly possible versions of multivalued dependencies and cross joins, as well as approximation measures of strongly possible keys, functional dependencies, multivalued dependencies, and cross joins. Among the many results, we mention that, while checking a given cross join in a complete table is polynomially solvable, checking whether a given strongly possible cross join holds in an incomplete table is NP-complete.

- The statistics of RDF stores is an essential tool used in the processes of query optimization. They are used to estimate the size of a query result and the time needed to evaluate a given query. The estimations are required to find the most efficient query evaluation plan for a given input query. Unfortunately, many RDF stores treat graphs as simple sets of vertices and edges without a conceptual schema. In *Type-based computation Of knowledge graph statistics*, Iztok Savnik, Kiyoshi Nitta, Riste Krekovski, and Nikolaus Augsten assume that a knowledge graph, including a complete RDF schema, is stored in an RDF store. The authors

propose and study a formal model for a knowledge graph, reminiscent of the relational database model.

We like to thank all authors for preparing, submitting, and revising their contributions to this special issue. We also thank all members of the FoIKS 2022 Program Committee, and we are deeply indebted to all reviewers of this special issue for their timely expertise in carefully reviewing the contributions.

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