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 10th International Symposium on Foundations of Information and Knowledge Systems (FoIKS 2018), which was held in Budapest, Hungary, during the week of May 14–18, 2018.

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. Speakers are given sufficient time to present their ideas and results within the larger context of their research. Furthermore, participants are asked in advance to prepare a first response to a contribution of another author in order to initiate discussion.

Previous FoIKS symposia were held in Linz (Austria) in 2016, Bordeaux (France) in 2014, Kiel (Germany) in 2012, Sofia (Bulgaria) in 2010, Pisa (Italy) in 2008, Budapest (Hungary) in 2006, Vienna (Austria) in 2004, Schloss Salzau near Kiel (Germany) in 2002, and Burg/Spreewald near Berlin (Germany) in 2000. FoIKS took up the tradition of the conference series Mathematical Fundamentals of Database Systems (MFDBS), which initiated East-West collaboration in the field of database theory. Former MFDBS conferences were held in Rostock (Germany) in 1991, Visegrád (Hungary) in 1989, and Dresden (Germany) in 1987.

FoIKS 2018 solicited original contributions on foundational aspects of information and knowledge systems. This included 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, information theory, complexity theory, algorithmics and computation, statistics, and optimization.

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FoIKS 2018 received 40 submissions, which have been carefully reviewed by international experts. 14 articles were accepted for long presentation. In addition, 6 articles were accepted for short presentation. The programme was completed by five invited talks kindly presented by Gerd Brewka, Laura Kovács, Sebastian Link, David Pearce, and Bernhard Thalheim.

After the symposium the authors of the papers judged best by the Program Committee were invited to prepare thoroughly revised and significantly extended versions of their conference contributions to be considered for inclusion into this special issue. All these were subject to a rigorous reviewing process. The following six accepted papers nicely reflect the wide range of topics covered by the FoIKS symposia:

- In their paper *Compilation of Static and Evolving Conditional Knowledge Bases for Computing Induced Nonmonotonic Inference Relations*, Christoph Beierle, Steven Kutsch and Kai Sauerwald present a new approach for implementing inference from conditional knowledge bases, which are a well-known formalism for representing defeasible rules in knowledge representation and reasoning. The method relies on previous research that has shown that the considered inference tasks can be phrased as a constraint satisfaction problem (CSP). The present article continues this line of work and considers a multi-phased compilation scheme in which an optimized CSP is constructed offline that can be utilized for online skeptical (conditional) query answering. Furthermore, it is described how changes to a conditional knowledge base can be done on the compilation, without the need for a complete recompilation from scratch. The results are also supported by experiments with the software system InfOCF that employs the proposed compilation scheme.
- In their paper *Checking Inference-Proofness of Attribute-Disjoint and Duplicate-Preserving Fragmentations*, Joachim Biskup and Marcel Preuß provide new insights and tools to deal with a notoriously difficult security problem known as database inference attack. This problem is hard due to the fact that own and partial confidential data always needs to be made available to legitimate agents. It is then difficult to mitigate the risk of enabling the receiver to infer sensitive information that she is not entitled to learn. In this work, the authors investigate inferences via combinatorial and entailment reasoning, identifying basic conditions for a fragmentation to violate inference-proofness. Based on this work, they further propose an efficient security tool to effectively check the inference-proofness of a given fragmentation, and experimentally evaluate its computational efficiency via a prototype.
- In the paper *Contextual Rational Closure for Defeasible $\mathcal{ALC}$* , Katarina Britz and Ivan Varzinczak tackle the problem of extending description logics to support defeasible reasoning. Such combinations are highly relevant both for non-monotonic reasoning and for ontological reasoning. More specifically, they introduce an extension of the description logic $\mathcal{ALC}$ to represent both defeasible constructs on complex concepts and contextual defeasible subsumption. The key idea is to induce a modular preference order on objects from each modular preference order on roles, and using these to relativise defeasible subsumption. This yields a notion of contextualised rational defeasible subsumption, with contexts described by roles. The paper provides a method for computing the (contextual) rational closure of a defeasible knowledge base in order to address the central problem of entailment.
- *First-Order Definable Counting-Only Queries* by Jelle Hellings, Marc Gyssens, Dirk Van Gucht and Yuqing Wu, deals with counting only queries over collections of sets of objects. A surprising number of practical queries over these collections can be

expressed as counting only queries. This means that quite often, in order to answer a given query it is not necessary to know to which sets each object (or group of objects) belongs to; it is enough to know in how many sets each object (or group of objects) appears. In this work, the authors present a highly sophisticated and deep study of different fragments of first-order definable counting only queries. In particular, they identify syntactic counting only fragments of first-order logic which can express many practically relevant queries beyond the usual well-behaved first-order queries, i.e., beyond conjunctive queries, monadic first-order logic and the two-variable fragments of first-order logic. At the same time, these counting only fragments are shown to be simply enough for satisfiability, validity, query containment, and query equivalence to be decidable.

- The paper *Voting-based Ensemble Learning for Partial Lexicographic Preference Forests over Combinatorial Domains* by Xudong Liu and Mirosław Truszczyński is located in the area of preferences, and brings together issues from knowledge representation with machine learning techniques. The authors propose to use forests of partial lexicographic preference trees (PLP-trees) to represent preference relations and then aggregate them according to various voting rules to obtain a single preference order. Their results reveal that the actual choice of a voting rule does not have a major effect on the aggregated order. Also the computational complexity of key reasoning tasks for the resulting models is studied. For the proposed PLP-forest preference models, methods to compute optimal and near-optimal outcomes, the tasks that appear difficult for some other common preference models, are presented. The paper also provides comparisons with models based on standard decision trees.
- In *A Framework for Comparing Query Languages in their Ability to Express Boolean Queries*, Dimitri Surinx, Jan Van den Bussche and Dirk Van Gucht, provide a comprehensive study of different modalities of expression of Boolean queries. Their main motivation is the observation that certain modalities can increase the expressive power of weak query languages, which have the advantage of been easy to use and efficient. For instance, conjunctive queries plus the containment modality can express integrity constraints that are not expressible with the standard nonemptiness modality. In this paper, the authors focus on three fundamental modalities: nonemptiness, emptiness and containment. The former two modalities naturally occur in query languages such as SQL and SPARQL. Many more modalities could be considered, but to consider them all would certainly be a never ending task. Nevertheless, the authors provide a general framework that constitutes a valuable tool to investigate these matters, and use this framework to prove interesting and non-trivial results regarding the effect of these modalities on the expressive power of the algebra of binary relations and the language of conjunctive queries.

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 2018 Program Committee for their valuable work in reviewing the submissions, all conference participants for fruitful discussions, and the local organization team of FoIKS 2018 under the lead of Attila Sali for being our hosts at the Alfréd Rényi Institute of Mathematics in Budapest. To make this special issue possible, we are particularly grateful to Martin Charles Golumbic for his encouragement and guidance through the whole process. Last but not least, we are deeply indebted to all reviewers of this special issue for their timely expertise in carefully reviewing the contributions.

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