Annals of Mathematics and Artificial Intelligence (2022) 90:145–147
https://doi.org/10.1007/s10472-021-09782-y

S701 FOIKS 2020

Preface

Andreas Herzig[1] · **Juha Kontinen**[2]

Accepted: 1 December 2021 / Published online: 27 December 2021

This special issue of the Annals of Mathematics and Artificial Intelligence contain thoroughly revised and significantly extended versions of selected papers presented at the Eleventh International Symposium on Foundations of Information and Knowledge Systems (FoIKS 2020, Dortmund, Germany, February 17–21, 2020). Previous FoIKS editions took place in Budapest (Hungary, 2018), Linz (Austria, 2016), Bordeaux (France, 2014), Kiel (Germany, 2012), Sofia (Bulgaria, 2010), Pisa (Italy, 2008), Budapest (Hungary, 2006), Vienna (Austria, 2004), Schloss Salzau (Germany, 2002), and Burg/Spreewald near Berlin (Germany, 2000).

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. Such disciplines include discrete mathematics, logic and algebra, model theory, information theory, complexity theory, algorithmics and computation, statistics and optimization.

FoIKS 2020 received 33 paper submissions, and after a careful evaluation of each paper by three reviewers the programme committee selected 19 papers for presentation at the symposium and publication in the proceedings. The conference program was completed by four invited talks by Jan Van den Bussche, Bernhard Nebel, Klaus-Dieter Schewe, and Anni-Yasmin Turhan.

FoIKS symposia provide a forum for intensive discussions: speakers are given ample time to present their results, expound relevant background information, and put their research into context. Furthermore, participants are asked in advance to prepare a first response to a contribution of another author in order to initiate discussion.

After the symposium the authors of the papers judged best by the Programme Committee were invited to prepare thoroughly revised and significantly extended versions of their

✉ Andreas Herzig
herzig@irit.fr

✉ Juha Kontinen
juha.kontinen@helsinki.fi

[1] IRIT-CNRS, 118 Route de Narbonne, Toulouse, 31062, France

[2] Department of Mathematics and Statistics, University of Helsinki, Pietari Kalmin katu 5, Helsinki, 00014, Finland

conference contributions to be considered for inclusion into this special issue. Based on a rigorous reviewing process, the 6 papers listed below have been selected for publication.

- In *Normal Forms of Conditional Knowledge Bases Respecting System P-Entailments and Signature Renamings*, Christoph Beierle and Jonas Haldimann propose several normal forms of conditional knowledge bases and study their usefulness in reasoning about conditionals. The first one, reduced antecedent normal form (RANF), is a refinement of a previous proposal and prevents redundancies, in the sense that inferred conditionals should not be explicitly stated. The second one, renaming normal form (ρNF), identifies knowledge bases having the same syntactic structure modulo the names of the propositional atoms. Two more normal forms are also put forward, namely renaming antecedent normal form (ρANF) and renaming reduced antecedent normal form (ρRANF). These normal forms provide a more succinct representation. Existence, uniqueness and equivalence are proved for each of them, and algorithms computing them are proposed.
- In *On Matrices and K-relations*, Robert Brijder, Marc Gyssens, and Jan Van den Bussche study the expressivity of query languages with matrix operations in relation to the operations of the relational algebra. In the paper the focus is on the so-called K-annotated relation algebra (ARA) and matrices whose entries vary over some semiring K. The paper shows that the matrix query language MATLANG corresponds to the extension of ARA by a composition operator assuming the database schemas and subexpressions are restricted to arities of at most two (ARA(2)+composition). Furthermore, MATLANG is also shown to be equivalent with ARA(3), and more generally ARA(r+1) and ARA(r)+composition are shown equi-expressive for k-ary queries over r-ary K-relations. The results of the paper show that, in addition to the applications of ARA e.g. in provenance, ARA can be also seen as a prominent query language for tensors and matrices.
- In *Diversity, Dependence and Independence*, Pietro Galliani and Jouko Väänänen propose a new theoretical framework generalising the concepts of dependence and independence that already exist and are well studied in very different settings, such as mathematics (linear algebra, field theory, probability theory), logic, and theoretical computer science (relational database theory). They introduce the notion of diversity rank function (drf), in the context of finite subsets of a given set, as a function mapping subsets to positive real numbers. Then y is defined to be dependent from x if adding it to x does not increase the amount of diversity, while y is independent from x if adding it to x increases maximally the amount of diversity. They provide examples which instantiate the general framework of drf's to different settings: constant diversity, singular diversity, two-valued diversity, uniform diversity, coverage diversity, relational diversity, algebraic diversity, and entropy. They then prove that matroids, introduced as a general theory of dependence in algebra, are a particular case of the (strictly) more general diversity rank function. They moreover extend two completeness results to the entire setting: Armstrong's axiomatisation of functional dependence and Geiger, Paz and Pearl's axiomatisation of probabilistic independence. They finally provide a representation theorem showing that every set of dependence statements satisfying Armstrong's Axioms arises from some diversity rank function.
- In *General Information Spaces: Measuring Inconsistency, Rationality Postulates, and Complexity*, John Grant and Francesco Parisi develop a general framework for determining the amount of inconsistency in a knowledge base. As most of the existing work in this area focuses on knowledge bases defined via sets of formulas of propositional

logic, the existing methods are not directly applicable to real-word systems. The paper generalizes inconsistency measuring to real world information via the concept of a general information space which encompasses various types of databases and scenarios in AI systems. The developed methods allow for the direct comparison of the inconsistency of different information spaces with differently represented data, as demonstrated by several case studies. Furthermore, the paper formulates several rationality postulates for general information space inconsistency measures and also considers the complexity of computing these measures for general information spaces.

- In *Parameterised Complexity of Model Checking and Satisfiability in Propositional Dependence Logic*, Yasir Mahmood and Arne Meier study the parameterized complexity of central decision problems of Propositional Dependence Logic for a variety of parameterizations including formula-size, team-size, arity of dependence atoms, and the number of variables. The results give a comprehensive picture of the complexity of model checking, satisfiability, and so-called m-satisfiability with respect to the chosen parameterizations. This paper is the first systematic study of the parameterised complexity of model checking and satisfiability in the (propositional) team semantics context.
- In *Structured Argumentation Dynamics: Undermining Attacks in Default Justification Logic*, Stipe Pandžić focuses on problems at the intersection of justification logic and formal argumentation. It is part of a more general project whose main aim is to model argumentation phenomena based on default justification logic, which is a logic framework with operational semantics that is due to the author. The present paper explores how to deal with undermining attacks in that logic, that is, attacks where argument premises are questioned. Such attacks are connected with dynamic operations that involve contraction or a variant of non-prioritized contraction. Finally, the trivialization problem and issues related to self-reference paradoxes (similar to the Liar Paradox) are discussed.

We would like to thank all authors for preparing, submitting, and revising their contributions to this special issue. We also thank all members of the FoIKS 2020 Program Committee, and we are deeply indebted to all reviewers of this special issue for their timely expertise in carefully reviewing the contributions.

Funding Open Access funding provided by University of Helsinki including Helsinki University Central Hospital.