EDITORIAL PREFACE

Special issue on logic and complexity

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In February 2022, the Centre International de Rencontres Mathématiques (CIRM) in Marseille, France held a thematic month on "Logic and Interactions." During the week of February 14–18, a workshop on logic, databases, and complexity was conducted. It has been widely acknowledged for years that these domains are closely related. For instance, fragments of first-order and second-order logic have been used since the 1970s to describe computational problems and express database queries. Logic has provided insights into complexity issues and strengthened the theoretical framework of database programing languages.

In recent years, new concepts and formalisms have revitalized these connections, including team-based logic. Their semantics are based on evaluating a first-order formula not for a single assignment to its free variables but for sets of such assignments, known as teams. The article discusses the extension of the logical language with team atoms to specify team properties, including functional dependency, which is important for team-based logic in databases.

This special issue collects contributions on these topics from the seminar participants. The area of databases was strongly represented in the program of the CIRM workshop, but this is not reflected here. The issue contains the following papers.

The paper "Logical Characterizations of Algebraic Circuit Classes over Integral Domains" by Barlag, Chudigiewitsch, and Gaube presents algebraic circuits over infinite integral domains and generalizes standard AC and NC classes for this setting. The authors discuss the logical characterization of the AC and NC hierarchies. Moreover, they introduce a formalism that enables the comparison of some of the aforementioned complexity classes with different underlying integral domains.

"Parameterized Complexity of Weighted Team Definability" by Kontinen, Mahmood, Meier, and Vollmer explores the complexity of weighted team definability for logic with team semantics. The authors focus on the parameterized complexity of weighted team definability for a fixed formula of central team-based logic and present several results on the problem's complexity. The text discusses dependence, independence, and inclusion logic formulas, as well as the relationship between the complexity of weighted team definability and the complexity classes in the W-hierarchy and paraNP.

Hella and Luosto's paper, "Game Characterizations for the Number of Quantifiers," presents a generalization of a game introduced by Immerman in 1981. The game characterizes equivalence of structures with respect to a given number of quantifiers for first-order sentences. The authors define three other games and prove their equivalence to the Immerman game, providing a characterization for the number of quantifiers required to separate structures. However, unlike the former, these are authentic two-player games.

The paper "Dimension in team semantics" by Hella, Luosto, and Väänänen introduces measures of complexity for families of sets, called dimensions, based on minimal number of convex

subfamilies needed for covering a given family. The authors apply their notions of dimensions for proving new hierarchy results for logics with team semantics. In particular, they prove that the expressive power of dependence, inclusion, independence, anonymity, and exclusion atoms strictly increases with arity.

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