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Preface

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This volume collects together extended and improved versions of papers presented at the twenty-second Workshop on Logic, Language, Information and, Computation (WoLLIC 2015) held at the School of Informatics and Computing, Indiana University, Bloomington, Indiana. WoLLIC is an annual international forum on inter-disciplinary research involving formal logic, computing and programming theory, and natural language and reasoning. Each meeting includes invited talks and tutorials as well as contributed papers. Contributions were invited on all appropriate subjects of Logic, Language, Information, and Computation, with particular interest in cross-disciplinary topics.

The scientific program of WoLLIC 2015 consisted of seven Invited Addresses, given by Nina Gierasimczuk *Learning in the Limit, General Topology, and Modal Logic*; John Harrison *Formalization of Mathematics for Fun and Profit*; Peter Jipsen *From Residuated Lattices via GBI-algebras to BAOs*; André Joyal *Categories of Games*; Mehrnoosh Sadrzadeh *Multi-Linear Algebraic Semantics for Natural Language*; Alexandra Silva *Towards a Nominal Chomsky Hierarchy* and Chung-chieh Shan *Splitting Hairs*. There were also four tutorials by Nina Gierasimczuk, John Harrison, André Joyal, and Alexandra Silva. The independent conference on *Computing Natural Reasoning*, which overlaps with WoLLIC in subject matter, was also physically collocated with WoLLIC 2015.

The proceedings of WoLLIC 2015, including invited and contributed papers, were published in advance of the meeting as volume 9160 of Springer's Lecture Notes in Computer Science (LNCS) series. In addition, abstracts were published in the Conference Report section of the *Logic Journal of the IGPL* (24(5):859–867, October 2016). This volume contains selected contributions that were extended and reviewed a second time for publication in Mathematical Structures in Computer Science (MSCS). Eight of the WoLLIC contributions have been expanded and improved for this issue. They showcase the broadness of research interests within the WoLLIC community.

Within the rubric of logic applied to *language* issues, Abrusci and Maieli's *Proof Nets for Multiplicative Cyclic Linear Logic and Lambek Calculus* presents a new intuitive syntax for proof nets for the multiplicative cyclic fragment of linear logic and a corresponding correctness criterion. These new proof nets provide a geometrical way of parsing natural language sentences, using proofnets for Lambek calculus parsing. Endrullis and Moss discuss in *Syllogistic Logic with "Most"* a sound and complete axiomatization of the logic of All X are Y, Some X are Y, and Most X are Y, interpreted on finite models by taking Most X are Y to mean that a strict majority of the Xs are Y. They also show that the decision problem for this language is decidable in polynomial time. Investigating 'small' systems of syllogistic logic is an important part of the connection between logic and language. On a different direction, Hedges and Sadrzadeh in *A Generalised Quantifier Theory of Natural Language in Categorical Compositional Distributional Semantics with Bialgebras* discuss generalized quantifiers in categorical compositional distributional semantics, a model of Natural Language semantics which combines the statistical vector space models of words with compositional models of grammar. Their underlying setting consists of compact closed categories with bialgebras, which they instantiate to both sets and relations and to finite dimensional vector

spaces and linear maps, and they prove the equivalence of the relational instantiation to the truth theoretic semantics of generalized quantifiers.

Under the rubric of logic applied to the formalization of *theoretical computer science*, Ghani, Forsberg and Orsanigo's *Parametric Polymorphism – Universally* gives a model-independent axiomatic treatment of parametric polymorphism by characterising Reynolds' definition via a universal property. They also show that Reynolds' results (the Identity Extension Lemma and the Abstraction Theorem) follow from this universal property in the axiomatic setting. Courtault, van Ditmarsch, and Galmiche in their *A Public Announcement Separation Logic* combine Separation Logic with the epistemological aspects of Public Announcement logic, and define a public announcement separation logic, providing a tableau system for it, that they prove sound and complete. The system considers possible words as resources, which can be shared and separated. They also provide a method for countermodel extraction for this logic. Mordido and Caleiro's *Probabilistic Logic over Equations and Domain Restrictions* develops a new probabilistic logic over an algebraic basis, including equations and domain restrictions, for which they show that the satisfiability problem is decidable, under the assumption that its algebraic basis is given by means of a convergent rewriting system. They provide a polynomial reduction to Satisfiability Modulo Theories and get that validity in the logic is also decidable. They use the system to show examples of verifying and estimating the probability of the existence of offline guessing attacks to cryptographic protocols. Concentrating on complexity theory, De Haan and Szymanik's *Characterizing Polynomial Ramsey Quantifiers* asks the natural question of which is the computational complexity of Ramsey quantifiers. In particular, they discuss whether all Ramsey quantifiers are either polynomial-time computable or Nondeterministic Polynomial Time hard, and whether one can give a natural characterization of the polynomial-time computable ones. This has a negative answer, as they show that there exist intermediate Ramsey quantifiers, which they proceed to characterize, via a dichotomy so that they can identify exactly which quantifiers lead to a polynomial-time solvable problem.

Finally, we need to end on a sad note. Our esteemed colleague Professor Zóltan Ésik, Professor of Computer Science and Head of the Department of Foundations of Computer Science, from the Institute of Informatics of the University of Szeged, Hungary, left us unexpectedly and untimely on 25th May, 2016, while visiting Reykjavik in Iceland. Zóltan was a distinguished scientist, a Fellow of the EATCS, an Elected member of the Academy of Europe (from 2010), the chair of the Presburger Award Committee (2015–2017), a member of Council of the European Association for Theoretical Computer Science (EATCS) (from 2003 to 2015), a member of the *International Federation for Information Processing*, since 2000, a member of the Board of the European Association for Computer Science Logic (EACSL) from 2005–2010 and of the Steering Committees of the conference series Fundamentals of Computer Science (FCT), Algebraic Informatics (CAI), Fixed Points in Computer Science (FICS), and Automata and Formal Languages (AFL). He was also a member of the editorial boards of Theoretical Computer Science (2000–2015), Theoretical Informatics and Applications, Acta Cybernetica, Alkalmazott Matematikai Lapok (Journal of Applied Mathematics), Algebra, Journal of Automata, Languages and Combinatorics, and former member of many other editorial boards. The Academy of Europe has an obituary for Zóltan at its website http://www.ae-info.org. Zóltan was one of the participants of WoLLIC 2015 and had already submitted his final version paper when tragedy intervened and he died while visiting Iceland. It seemed to us only fair to publish his paper *Equational properties of stratified least fixed points*, as submitted. It had been accepted for the journal issue, as customary, with suggested improvements. We thank the reviewers for their effort, but regret that, in this occasion, sadly, their suggestions could not be heeded.

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