Games, Automata, Logics, and Formal Verification (GandALF2014) – Preface

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This issue contains a collection of 8 papers that were selected among the 3 invited contributions and the 19 papers accepted for presentation at the Fifth International Symposium on Games, Automata, Logic and Formal Verification(GandALF 2014). The symposium took place in Verona, Italy, from 10th to 12th of September 2014. The GandALF symposium was established by a number of Italian computer scientists interested in mathematical logic, automata theory, game theory, and their applications to the specification, design, and verification of complex systems. It aims at providing a forum where people from different areas, and possibly with a different background, can fruitfully interact. Even though the idea of the symposium emerged within the Italian research community, the event has a truly international nature, as witnessed by the composition of the conference committees and by the country distribution of the submitted papers. The authors invited to contribute to the special issue were asked to submit an extended and revised version of their GandALF paper. The submitted papers went through a careful two-phase review process. The collection of papers in this issue covers a variety of topics in game theory (graph games, pushdown modular games), logics (Propositional dependence logics, Propositional Dynamic Logic, First-order logic on graphs), and automata theory (Parametric Timed Automata, Automata for unordered unranked trees,Tree trasducers).

The paper Petri Games: Synthesis of Distributed Systems with Causal Memory, coauthored by Bernd Finkbeiner, Ernst-Rüdiger Olderogb, presents a new multiplayer game model for the interaction and the flow of information in a distributed system. The players are tokens on a Petri net. As long as the players move in independent parts of the net, they do not know of each other; when they synchronize at a joint transition, each player gets informed of the causal history of the other player. They show that for Petri games with a single environment player and an arbitrary bounded number of system players, deciding the existence of a safety strategy for the system players is EXPTIME-complete.

The paper Visibly Pushdown Modular Games, coauthored by Ilaria De Crescenzo,Salvatore La Torre, Yaron Velner, considers games on recursive game graphs. In such games, the most natural notion of strategy is the modular one, i.e., a strategy that is local to a module and is oblivious to previous module

invocations, and thus does not depend on the context of invocation. The author study modular strategies with respect to winning conditions that can be expressed as a pushdown automaton showing that pushdown modular games are undecidable in general, and become decidable for visibly pushdown automata specifications. They show that modular games with a universal Büchi or co-Büchi visibly pushdown winning condition are Exptime-complete, and when the winning condition is given as a CaRet or Nwtl temporal logic formula the problem is 2Exptime-complete, and it remains 2Exptime-hard even for simple fragments of these logics.

The paper Complexity of Validity for Propositional Dependence Logics, by Jonni Virtema, studies the complexity of the validity problems of propositional dependence logic, modal dependence logic, and extended modal dependence logic. The author shows that the validity problem for propositional dependence logic is NEXPTIMEcomplete.In addition, the paper establishes that the corresponding problems for modal dependence logic and extended modal dependence logic coincide. Moreover, the containment in NEXPTIME^{NP} is shown, whereas NEXPTIME-hardness follows from the propositional case.

The paper Parametric Linear Dynamic Logic, coauthored by Peter Faymonville, Martin Zimmermann, introduce Parametric Linear Dynamic Logic (PLDL), which extends Linear Dynamic Logic (LDL) by temporal operators equipped with parameters that bound their scope. By adding parameterized operators to LDL, the authors obtain a logic that is able to express all ω-regular properties and that subsumes parameterized extensions of LTL like Parametric LTL and PROMPT-LTL. The main technical contribution is a translation of PLDL formulas into nondeterministic Büchi automata of exponential size via alternating automata. This yields polynomial space algorithms for model checking and assume-guarantee model checking and a realizability algorithm with doubly-exponential running time.

The paper On the Path-Width of Integer Linear Programming coauthored by Constantin Enea, Peter Habermehl, Omar Inverso, Gennaro Parlato show that solutions of any instance of the problem Integer Linear Programming (ILP) can be naturally represented by an FO-definable class of graphs. One of the graphs representing a solution is of path-width at most 2^n, where n is the number of variables in the instance. Since FO is decidable on graphs of bounded path-width, the technique allows to obtain an alternative decidability result for ILP.

The paper On Parametric Timed Automata and One-Counter Machines by Daniel Bundala, Joel Ouaknine establishes a correspondence between reachability in parametric timed automata with at most two parametric clocks (and arbitrarily many nonparametric clocks) and reachability for a certain class of parametric one-counter machines. Then, the authors leverage this connection: to improve Alur et al.'s decision procedure for one parametric clock from nonelementary to 2NEXP; to show decidability for two parametric clocks provided the timed automaton uses only a single parameter; to show decidability for various resulting classes of parametric one-counter machines; and to show decidability of reachability for the simple programs of Ibarra et al. in the presence of a single parameter. In addition, they prove that for one and two parametric clocks the

reachability problem is NEXP-hard and PSPACENEXP-hard respectively.

The paper Deterministic Automata for Unordered Trees by Adrien Boiret, Vincent Hugot, Joachim Niehren, Ralf Treinen proposes and investigates different notions of horizontal determinism, starting from automata for unranked trees in which the horizontal evaluation is performed by finite state automata. The author show that a restriction to confluent horizontal evaluation leads to polynomial-time emptiness and universality, but still suffers from coNP-completeness of the emptiness of binary intersections. Moreover, they show that efficient algorithms can be obtained by imposing an order of horizontal evaluation globally for all automata in the class. Depending on the choice of the order, different classes of automata can be obtained, each of which has the same expressiveness as Counting Mso.

The paper Synthesis of Deterministic Top-down Tree Transducers from Automatic Tree Relations by Sarah Winter, Christof Löding considers the synthesis of deterministic tree transducers from automaton definable specifications, given as binary relations, over finite trees. In particular, they consider the case of tree automatic specifications, i.e. specifications recognizable by a top-down tree automaton that reads the two given trees synchronously in parallel. For specifications that are deterministic top-down tree automatic, the author provide decision procedures for both bounded and arbitrary delay that yield deterministic top-down tree transducers which realize the specification for valid input trees. For general nondeterministic tree-automatic specifications the paper solves some restricted cases.

We would like to thank all authors of submitted papers and all the anonymous reviewers for their invaluable work in refereeing the papers. We would also like to thank Becky Shepardson for his kindness and competence in assisting us to prepare this special issue. We hope that you will enjoy reading these papers.

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