Sasha Rubin 3.2017

Expression of Interest for RTD-A and RTD-B

Contents

1 Personal Details

Affiliation: University of Naples "Federico II", Italy.
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2 Motivation Letter

Academic Interests: My main academic trajectory is to contribute to foundations of Formal Methods (FM) for Artificial Intelligence (AI). This is motivated by the problem of developing AI techniques that are dependable and explainable, i.e., as the use of AI explodes in everyday life we desire guarantees that the AI systems are correct (dependable AI), and ways to enable users to understand why an AI system takes the actions it does (explainable AI). My focus has been on modeling, specification and verification of discrete systems, especially multi-agent systems (i.e., systems consisting of multiple rational agents, distributed in space, with possibly conflicting goals, in an unpredictable or unknown environment). In my work I have used and developed techniques based on mathematical logic, automata theory, game theory and graph theory.

I have built a large network of collaborators, and have connections with a number of groups, including those in Naples (Murano), Rome (De Giacomo), Barcelona (Geffner), Imperial (Lomuscio), Oxford (Wooldridge) and Rice (Vardi). I will share these collaborations with students and faculty at GSSI.

Projected Teaching/Supervision Activities: I have collaborated with a number of PhD students [26, 18, 15, 10, 4, 3], a number of undergraduate students [21,22,23], and am a Program Committee member for IRISA Master Research Internship 2016-2017. I will continue to collaborate with PhD students: exciting PhD topics include parameterised synthesis (known as "generalised planning" in the AI literature), rational synthesis and the problem of computing equilibria (a topic at the intersection of Game Theory and FM), foundations and applications of quantitative specification languages, and connections between automata theory and classical subfields of AI such as argumentation theory.

I would like to teach courses such as "Introduction to Formal Methods", "Games and Automata for Verification and Synthesis", "Introduction to Multi-agent Systems" and "Logics for Multi-agent Systems".

Projected Research Activities: I project two main research activities at GSSI.

I intend to investigate normal and speculative questions in Formal Methods with application to Multi-agent Systems.[1] I plan to investigate foundational issues (modeling, verification, synthesis) in formal methods of parameterised/distributed systems and networks, and investigate more speculative issues such as "What is synthesis and how can it be formalised?" (an active topic of debate, and the topic of work in progress).

A second goal, building on the first, and arguably more important, is that I intend contribute to building bridges between the Formal Methods (FM) and the Artificial Intelligence (AI)/Multi-agent systems (MAS) communities. I recently co-organised the First Workshop on Formal Methods in Artificial Intelligence[2] and look forward to future editions.

3 University Positions

Fellow 03.2017 – present

Fellow of the ASTREA lab,[3] University of Naples "Federico II", Italy.

Postdoctoral Researcher 03.2015 – 03.2017

University of Naples "Federico II", Italy.
Marie Curie fellow of the National Institute of Higher Mathematics (INdAM "F. Severi").
INdAM-COFUND-2012, FP7-PEOPLE-2012-COFUND, Proj. ID 600198.

Postdoctoral Researcher 03.2014 – 02.2015

Institute for Information Systems, Technical University of Vienna, Austria and Institute of Applied Information Processing and Communications, Technical University of Graz, Austria.

Postdoctoral Researcher 03.2012 – 03.2014

Institute for Information Systems, Technical University of Vienna, Austria, and IST Austria

[1] I use "normal" in a similar sense to Kuhn's "normal science", i.e., research acknowledged for a time as supplying the foundation for its further practice.

[2] https://sites.google.com/site/fmai2017homepage/home

[3] http://people.na.infn.it/~murano/

Visiting Researcher 05.2010 – 03.2012
Department of Computer Science, University of Auckland, New Zealand.
Including research visits to: Tel Aviv University, Israel; University of Naples, Italy; University of Paris Diderot, France.

Visiting Lecturer 02.2010 – 05.2010
Department of Mathematics, University of Cape Town, South Africa.

Visiting Researcher 12.2009 – 02.2010
Department of Computer Science, University of Auckland, New Zealand.

Visiting Assistant Professor 08.2008 – 12.2009
Department of Mathematics, Cornell University, USA.

Honorary Research Fellow 12.2004 – 08.2008
Department of Computer Science, University of Auckland, New Zealand.
New Zealand Science and Technology Postdoctoral Fellowship UOAX0413.

PhD Department of Mathematics and Department of Computer Science 2004
University of Auckland, New Zealand.
Supervisor: Bakhadyr Khoussainov
Title: Automatic Structures
Awards: Prize for the best doctoral thesis in the Faculty of Science, and Montgomery memorial prize in logic from the Department of Philosophy.

MSc Department of Mathematics and Department of Computer Science 1998
University of Auckland, New Zealand.
Award: First Class.

BSc Department of Mathematics and Department of Computer Science 1997
University of Cape Town, South Africa
Award: Dean's Merit List.

4 Brief Research Statement

I work in formal methods for artificial intelligence and multi-agent systems with a focus on foundational issues and using mathematical logic and automata theory for describing, reasoning about and controlling systems.

Classification ACM Computing Classification System: Theory of Computation [Models of Computation, Logic, Formal Languages and Automata Theory]; Computing Methodologies [Artificial Intelligence: Planning and Scheduling, Knowledge Representation and Reasoning, Distributed Artificial Intelligence]

Mathematics Subject Classification: 03Bxx (General Logic), 03Cxx (Model Theory); 68Qxx (Theory of Computing), 68Txx (Artificial Intelligence)

Main Areas

Formal methods (Modeling, Verification, Synthesis) of Multi-agent Systems (including Parameterised Systems, Distributed Systems, Probabilistic Systems, Timed Systems); Logics for Games and Strategic Reasoning; Foundations of Planning; Automata Theory; Finite and Algorithmic Model Theory.

Accomplishments

During my PhD I (and my co-authors) pioneered the development of the theory of automatic structures. My most cited publications in this area are: [33] (95 citations; all citation counts are as reported by Google Scholar) and [28] (85 citations). My PhD thesis (67 citations) was awarded the Vice-chancellor's prize for the best doctoral thesis in the Faculty of Science, and Montgomery memorial prize in logic from the Department of Philosophy.

I was then awarded a prestigious New Zealand Science and Technology Postdoctoral Fellowship. During this fellowship, I published a survey and extension of the main results in my thesis in the Bulletin of Symbolic Logic [28], and I (with a PhD student of Erich Grädel's) solved a 12 year-old conjecture of Courcelle's [26].

In the last few years, I (with my co-authors) generalised a cornerstone paper on verification of parameterised systems ("Reasoning about Rings", E.A. Emerson, K.S. Namjoshi, POPL, 1995) from ring topologies to arbitrary topologies (35 citations) [18]. We also completed a book, published by Morgan & Claypool, surveying decidability results in parameterised verification [15].

Recently, I was awarded a two year Marie-Curie fellowship from the Istituto Nazionale di Alta Matematica to work on formal methods for parameterised light-weight mobile agents. I opened this direction with [17]. Subsequently (with my co-authors) I continued this direction and published in top rated conferences [5], [12] and won a best-paper award [16] (invited to JAAMAS.)

5 Awards and Distinctions

- 2 individual fellowships (Marie Curie fellow of INdAM, New Zealand Science and Technology Postdoctoral Fellowship).
- 2 PhD prizes (best doctoral thesis in the Faculty of Science, Montgomery memorial prize in logic from the Department of Philosophy).
- 6 Invited Workshop-Talks
  - *Verification of Multi-Agent Systems with Imperfect Information and Public Actions*, Naples, Italy 02.2017
  - *Finite and Algorithmic Model Theory*, Les Houches, France 05.2012
  - *Automata theory and Applications*, IMS programme, Singapore 09.2011
  - *Computational Model Theory*, CNRS SIG, Bordeaux, France 06.2008
  - *Algorithmic-Logical Theory of Infinite Structures*, Dagstuhl, Germany 10.2007
  - *Finite and Algorithmic Model Theory*, Newton Institute, England 01.2006
  - *Workshop on Automata, Structures and Logic*, Auckland, New Zealand 12.2004
- Competed as part of a team of three, in the world finals of the 1998 ACM Programming Contest in Atlanta, Georgia USA, representing the University of Auckland and New Zealand.

6 Recent Research visits

- Host: Mike Wooldridge, Oxford University — 03.2016, 01.2017
  Topic: Rational Synthesis
- Host: Alessio Lomuscio, Imperial College London — 03.2016, 01.2017
  Topic: Strategic-Epistemic logics for Multi-Agents Systems
- Host: Diego Calvanese, University of Bolzanno — 07.2016
  Topic: Data-aware strategic logics
  Topic: Knowledge Representation for Business Process Management
- Host: Frank Stephan and Sanjay Jain, National University of Singapore — 05.2016
  Topic: Learning Theory and Verification
- Host: Giuseppe De Giacomo, Sapienza, Rome — 12.2015
  Topic: Synthesis under Assumptions
  Topic: Generalised Planning with Partial Observability
- Host: Helmut Veith, TU Wien — 08.2015
  Topic: Logic and Impossibility Results in Distributed Computing
  Topic: Abstractions for Fault-tolerant Distributed Algorithms

7 Teaching and Supervision

I have a passion for teaching, and a proactive approach to learning best-practices. I spent 1.5 years teaching undergraduate calculus at Cornell. I sought out a number of teaching mentors, including Maria Terrell (Department of Mathematics) and David Way (associate director of the Cornell University Centre for Teaching Excellence) to discuss successful teaching strategies, both philosophical and concrete. As a result, according to my student evaluations, I was clear, organised, proactively willing to help, and motivating.

I have a strong record of undergraduate supervision. While at Cornell I mentored six students for three months in a research programme. This resulted in two publications [21], [23] and gave students a taste of research to help them decide if they should pursue a PhD. While at IST Austria I co-mentored one intern which resulted in [22]. While in Naples, I worked closely with two PhD students, resulting in [3], [4], [10].

Teaching

- Games for Verification (graduate) — 2017
  University of Naples "Federico II", DIETI
- Logic and Computation (undergraduate) — 2010
  University of Cape Town, Department of Mathematics
- Logical Definability and Random Graphs (graduate) — 2009
  Cornell University, Department of Mathematics
- Totally Awesome Mathematics (undergraduate) — 2009
  Two interactive lectures:
  i) Hilbert's Hotel and Infinite Cardinals
  ii) Algorithms and Termination
  Cornell University, Department of Mathematics

– Calculus for Engineers (undergraduate) 2008 – 2009
Cornell University, Department of Mathematics

– Discrete Structures in Mathematics and Computer Science (undergraduate) 2007
Mathematical Foundations of Software Engineering (undergraduate)
University of Auckland, Department of Computer Science

– Logic and Computation in Finitely Presentable Infinite Structures (co-taught five day advanced course) 2006
European Summer School in Logic, Language and Information

– Introduction to Formal Verification (advanced undergraduate) 2003
University of Auckland, Department of Computer Science

– Automata Theory (undergraduate) 2002
University of Auckland, Department of Computer Science

– Pre-calculus (undergraduate) 2001
University of Wisconsin, Madison, Department of Mathematics

Supervision

– Summer undergraduate project 2012
Topic: Edit-distance and Formal Languages.
IST Austria

– Summer research experience for undergraduates (REU) 2009
Topic 1: Parity Games.
Topic 2: Automatic Structures with Advice.
Cornell University, Department of Mathematics

8 Recent service

– I am co-chair of the Italian Conference on Theoretical Computer Science (ICTCS) 2017 (ictcs2017.unina.it), co-chair of the International Workshop on Strategic reasoning (SR) 2017 (http://sr2017.csc.liv.ac.uk/), and a co-organiser of the Italian Conference on Computational Logic (CILC) 2017 (http://cilc2017.unina.it/).

– I am a PC member of the International Joint Conference on Artificial Intelligence (IJCAI) 2017, the AAAI Conference on Artificial Intelligence (AAAI) 2017, the International Workshop of Strategic Reasoning (SR) 2016, the International Symposium on Games, Automata, Logics and Formal Verification (GandALF) 2016, and the European Conference on Artificial Intelligence (ECAI) 2016.

– I co-organised the First Workshop on Formal Methods in AI (FMAI) 2017.
https://sites.google.com/site/fmai2017homepage/home

– I am a Program Committee member for IRISA Master Research Internship 2016-2017.

– Between 2013 and 2016 I was involved in reviewing and assisting with the Handbook of Model Checking, to be published by Springer, and edited by Edmund Clarke, Thomas Henzinger and Helmut Veith.

– In 2014, I assisted Helmut Veith with writing and editing consortium grant applications and reports.

– In 2014, I volunteered for the Vienna Summer of Logic, the largest event in the history of logic.
http://vsl2014.at/

– In 2012/2013 I was one of the organisers of the IST Austria Young Scientist Symposium on the topic 'Understanding Shape: *in silico* and *in vivo*'.
ist.ac.at/young-scientist-symposium-2013/

– In 2012 I formed and ran the computer science seminar at IST Austria whose goal was to foster collaborations within the institute between computer scientists and, at the time, biologists.
ist.ac.at/computer-science-seminar/

– In 2010 I briefly volunteered at a secondary school in Accra, Ghana, teaching, observing and commenting on grade 5 mathematics classes. I also briefly volunteered in Khayelitsha, South Africa, helping high-school students prepare for their mathematics exams.

– I have reviewed for the following:
Journals: Artificial Intelligence, Journal of Symbolic Logic, Logical Methods in Computer Science, Theory of Computing Systems, Central European Journal of Mathematics, Information and Computation, Journal of Logic and Computation, Annals of Mathematics and Artificial Intelligence, Theory and Practice of Logic Programming.
Books: Handbook of Model Checking.
Conferences: KR, AAMAS, AAAI, EUMAS, ECAI, LICS, STACS, ICALP, MFCS, CONCUR, CSL, FoSSaCS, FSTTCS, SR, KRR@SAC, CiE, GandALF, RV, LPAR, LATA.

9 References

Academic

Bakhadyr Khoussainov — PhD Supervisor
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Roderick Bloem — Previous Employer and Collaborator
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roderick.bloem@iaik.tugraz.at

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DIETO, Università degli Studi di Napoli "Federico II"
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Erich Grädel — Previous Collaborator
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Frank Stephan — Previous Collaborator
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Teaching

Maria Terrell
Director of Teaching Assistant Programs, Cornell University
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Supervision

Bob Strichartz
Department of Mathematics, Cornell University
str@math.cornell.edu

10 Publications

I have 38 refereed publications including 1 (co-authored) book, 1 (sole authored) book-chapter, 8 journal articles (5 of them invited), 5 LICS papers, 4 AAMAS papers, 3 STACS papers, 1 IJCAI paper, 1 KR paper, and a best-paper at PRIMA. Not listed, are 6 invited journal articles (in preparation or under evaluation) and an invited chapter in a handbook on automata theory and applications (J.E. Pin (ed.), to be published by EMS).

Refereed publications in reverse-chronological order

[1] Francesco Belardinelli, Alessio Lomuscio, Aniello Murano, and Sasha Rubin. "Verification of Multi-agent Systems with Imperfect Information and Public Actions". In: *Proceedings of the 2017 International Conference on Autonomous Agents & Multiagent Systems, São Paulo, May 8-12, 2017*. 2017.

[2] Raphael Berthon, Bastien Maubert, Aniello Murano, Sasha Rubin, and Moshe Vardi. "Hierarchical Strategic Reasoning". In: *LICS 2017*. 2017.

[3] Benjamin Aminof, Vadim Malvone, Aniello Murano, and Sasha Rubin. "Graded Strategy Logic". In: *Proceedings 4th International Workshop on Strategic Reasoning, SR 2016, New York, USA*. 2016.

[4] Benjamin Aminof, Vadim Malvone, Aniello Murano, and Sasha Rubin. "Graded Strategy Logic: Reasoning about Uniqueness of Nash Equilibria". In: *Proceedings of the 2016 International Conference on Autonomous Agents & Multiagent Systems, Singapore, May 9-13, 2016*. 2016, pp. 698–706.

[5] Benjamin Aminof, Aniello Murano, Sasha Rubin, and Florian Zuleger. "Automatic Verification of Multi-Agent Systems in Parameterised Grid-Environments". In: *Proceedings of the 2016 International Conference on Autonomous Agents & Multiagent Systems, Singapore, May 9-13, 2016*. 2016, pp. 1190–1199.

[6] Benjamin Aminof, Aniello Murano, Sasha Rubin, and Florian Zuleger. "Prompt Alternating-Time Epistemic Logics". In: *Principles of Knowledge Representation and Reasoning: Proceedings of the Fifteenth International Conference, KR 2016, Cape Town, South Africa, April 25-29, 2016*. 2016, pp. 258–267.

[7] Benjamin Aminof and Sasha Rubin. "First Cycle Games". In: *Information and Computation,* (2016). DOI: http://dx.doi.org/10.1016/j.ic.2016.10.008.

[8] Benjamin Aminof and Sasha Rubin. "Model Checking Parameterised Multi-token Systems via the Composition Method". In: *Automated Reasoning - 8th International Joint Conference, IJCAR 2016, Coimbra, Portugal, June 27 - July 2, 2016, Proceedings*. 2016, pp. 499–515.

[9] Roderick Bloem, Swen Jacobs, Ayrat Khalimov, Igor Konnov, Sasha Rubin, Helmut Veith, and Josef Widder. "Decidability in Parameterized Verification". In: *SIGACT News* 47.2 (2016), pp. 53–64.

[10] Giuseppe De Giacomo, Antonio Di Stasio, Aniello Murano, and Sasha Rubin. "Imperfect information games and generalized planning". In: *International Joint Conference on Artificial Intelligence (IJCAI 2016)*. 2016.

[11] Benjamin Aminof, Aniello Murano, and Sasha Rubin. "On CTL* with Graded Path Modalities". In: *Logic for Programming, Artificial Intelligence, and Reasoning - 20th International Conference, LPAR-20 2015, Suva, Fiji, November 24-28, 2015, Proceedings*. 2015, pp. 281–296.

[12] Benjamin Aminof, Aniello Murano, Sasha Rubin, and Florian Zuleger. "Verification of Asynchronous Mobile-Robots in Partially-Known Environments". In: *PRIMA 2015: Principles and Practice of Multi-Agent Systems - 18th International Conference, Bertinoro, Italy, October 26-30, 2015, Proceedings*. 2015, pp. 185–200.

[13] Benjamin Aminof, Sasha Rubin, Francesco Spegni, and Florian Zuleger. "Liveness of Parameterized Timed Networks". In: *Automata, Languages, and Programming - 42nd International Colloquium, ICALP 2015, Kyoto, Japan, July 6-10, 2015, Proceedings, Part II*. 2015, pp. 375–387.

[14] Benjamin Aminof, Sasha Rubin, and Florian Zuleger. "On the Expressive Power of Communication Primitives in Parameterised Systems". In: *Logic for Programming, Artificial Intelligence, and Reasoning - 20th International Conference, LPAR-20 2015, Suva, Fiji, November 24-28, 2015, Proceedings*. 2015, pp. 313–328.

[15] Roderick Bloem, Swen Jacobs, Ayrat Khalimov, Igor Konnov, Sasha Rubin, Helmut Veith, and Josef Widder. *Decidability of Parameterized Verification*. Synthesis Lectures on Distributed Computing Theory. Morgan & Claypool Publishers, 2015.

[16] Aniello Murano, Giuseppe Perelli, and Sasha Rubin. "Multi-agent Path Planning in Known Dynamic Environments". In: *PRIMA 2015: Principles and Practice of Multi-Agent Systems - 18th International Conference, Bertinoro, Italy, October 26-30, 2015, Proceedings*. 2015, pp. 218–231.

[17] Sasha Rubin. "Parameterised Verification of Autonomous Mobile-Agents in Static but Unknown Environments". In: *Proceedings of the 2015 International Conference on Autonomous Agents and Multiagent Systems, AAMAS 2015, Istanbul, Turkey, May 4-8, 2015*. 2015, pp. 199–208.

[18] Benjamin Aminof, Swen Jacobs, Ayrat Khalimov, and Sasha Rubin. "Parameterized Model Checking of Token-Passing Systems". In: *Verification, Model Checking, and Abstract Interpretation - 15th International Conference, VMCAI 2014, San Diego, CA, USA, January 19-21, 2014, Proceedings*. 2014, pp. 262–281.

[19] Benjamin Aminof, Tomer Kotek, Sasha Rubin, Francesco Spegni, and Helmut Veith. "Parameterized Model Checking of Rendezvous Systems". In: *CONCUR 2014 - Concurrency Theory - 25th International Conference, CONCUR 2014, Rome, Italy, September 2-5, 2014. Proceedings*. 2014, pp. 109–124.

[20] Benjamin Aminof and Sasha Rubin. "First Cycle Games". In: *Proceedings 2nd International Workshop on Strategic Reasoning, SR 2014, Grenoble, France, April 5-6, 2014*. 2014, pp. 83–90.

[21] Andrey Grinshpun, Pakawat Phalitnonkiat, Sasha Rubin, and Andrei Tarfulea. "Alternating traps in Muller and parity games". In: *Theor. Comput. Sci.* 521 (2014), pp. 73–91.

[22] Krishnendu Chatterjee, Siddhesh Chaubal, and Sasha Rubin. "How to Travel between Languages". In: *Language and Automata Theory and Applications - 7th International Conference, LATA 2013, Bilbao, Spain, April 2-5, 2013. Proceedings*. 2013, pp. 214–225.

[23] Alex Kruckman, Sasha Rubin, John Sheridan, and Ben Zax. "A Myhill-Nerode theorem for automata with advice". In: *Proceedings Third International Symposium on Games, Automata, Logics and Formal Verification, GandALF 2012, Napoli, Italy, September 6-8, 2012*. 2012, pp. 238–246.

[24] Alexander Rabinovich and Sasha Rubin. "Interpretations in Trees with Countably Many Branches". In: *LICS 2012, Proceedings of the 27th Annual IEEE Symposium on Logic in Computer Science, Dubrovnik, Croatia, June 25-28, 2012*. 2012, pp. 551–560.

[25] Vince Bárány, Erich Grädel, and Sasha Rubin. "Automata-based presentations of infinite structures". In: *Finite and Algorithmic Model Theory*. Ed. by Javier Esparza, Christian Michaux, and Charles Steinhorn. Cambridge Books Online. Cambridge University Press, 2011, pp. 1–76.

[26] Tobias Ganzow and Sasha Rubin. "Order-Invariant MSO is Stronger than Counting MSO in the Finite". In: *STACS 2008, 25th Annual Symposium on Theoretical Aspects of Computer Science, Bordeaux, France, February 21-23, 2008, Proceedings*. 2008, pp. 313–324.

[27] Lukasz Kaiser, Sasha Rubin, and Vince Bárány. "Cardinality and counting quantifiers on omega-automatic structures". In: *STACS 2008, 25th Annual Symposium on Theoretical Aspects of Computer Science, Bordeaux, France, February 21-23, 2008, Proceedings*. 2008, pp. 385–396.

[28] Sasha Rubin. "Automata Presenting Structures: A Survey of the Finite String Case". In: *Bulletin of Symbolic Logic* 14.2 (2008), pp. 169–209.

[29] Bakhadyr Khoussainov, André Nies, Sasha Rubin, and Frank Stephan. "Automatic Structures: Richness and Limitations". In: *Logical Methods in Computer Science* 3.2 (2007).

[30] Bakhadyr Khoussainov and Sasha Rubin. "Decidability of Term Algebras Extending Partial Algebras". In: *Computer Science Logic, 19th International Workshop, CSL 2005, 14th Annual Conference of the EACSL, Oxford, UK, August 22-25, 2005, Proceedings*. 2005, pp. 292–308.

[31] Bakhadyr Khoussainov, Sasha Rubin, and Frank Stephan. "Automatic linear orders and trees". In: *ACM Trans. Comput. Log.* 6.4 (2005), pp. 675–700.

[32] Doron Bustan, Sasha Rubin, and Moshe Y. Vardi. "Verifying omega-Regular Properties of Markov Chains". In: *Computer Aided Verification, 16th International Conference, CAV 2004, Boston, MA, USA, July 13-17, 2004, Proceedings*. 2004, pp. 189–201.

[33] Bakhadyr Khoussainov, André Nies, Sasha Rubin, and Frank Stephan. "Automatic Structures: Richness and Limitations". In: *LICS 2004, 19th IEEE Symposium on Logic in Computer Science, 14-17 July 2004, Turku, Finland, Proceedings*. 2004, pp. 44–53.

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