

# Jakob Nordström

## *Curriculum Vitae*

School of Electrical Engineering and Computer Science  
KTH Royal Institute of Technology  
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### **Research Interests**

Computational complexity, proof complexity, SAT solving

### **Education and Degrees**

- 2015 Docent degree (habilitation) in Computer Science at KTH Royal Institute of Technology, Stockholm, Sweden
- 2008 PhD in Computer Science at KTH under the supervision of Professor Johan Håstad
- 2001 MSc in Computer Science and Mathematics at Stockholm University, Sweden
- 1999-2003 Russian studies up to finished C-level (equivalent of one and a half year's full-time studies) at Uppsala University and Stockholm University, Sweden
- Summer 1993 Karolinska Institute Biomedical Research School, Stockholm, Sweden
- 1993 Higher Certificate from the Natural Sciences Programme with extended music education at Stockholm Music Upper Secondary School, Sweden
- 1992 Diploma in Choir Conducting with extended Music Theory from Tallinn Music Upper Secondary School and the Tallinn Conservatory, Estonia

### **Positions Held**

- 2015-present Associate Professor at KTH Royal Institute of Technology
- 2011-2015 Assistant Professor at KTH
- 2008-2010 Postdoctoral researcher at the Massachusetts Institute of Technology hosted by Professor Madhu Sudan
- 2002-2008 Research assistant position sponsored by the President of KTH (one of 5-7 "Excellence PhD positions" awarded yearly based on undergraduate record)
- 2000/2001 Master's thesis project at Prover Technology
- 1996-1999 Teaching assistant at the Department of Mathematics, Stockholm University

### **Teaching**

Main lecturer on the following courses at KTH:

- Complexity Theory, MSc/PhD level, 2013/14, 2015/16, 2017/18
- Seminars on Theoretical Computer Science: Proof Complexity, MSc/PhD level, 2016/17
- Seminars on Theoretical Computer Science: Algebraic Gems in TCS, MSc/PhD level, 2014/15
- Seminars on Theoretical Computer Science: Communication Complexity, MSc/PhD level, 2012/13
- Current Research in Proof Complexity, MSc/PhD level, 2011/12

Lecturer on other courses:

- International Summer School on Satisfiability, Satisfiability Modulo Theories, and Automated Reasoning, Lisbon, Portugal, 2016
- Estonian Winter School in Computer Science (EWSCS '12), Palmse, Estonia, 2012

Teaching assistant on the following courses at KTH:

- Advanced Algorithms, MSc level, 2005/06
- Algorithms, Data Structures and Complexity, BSc level, 2002/03, 2003/04, 2004/05, 2005/06
- Fundamentals of Computer Science, BSc level, 2002/03, 2003/04, 2004/05
- Complexity Theory, MSc/PhD level, 2003/04

Teaching assistant on the following courses at Stockholm University:

- Algebra and Geometry part 1, BSc level, 1998/99
- Using Computers in Mathematics, MSc level, 1998/99
- Introductory Level course in Mathematics 1996/97
- Mathematical Analysis parts 1 and 2, BSc level, 1996/97

## **Supervision**

PhD students:

- Marc Vinyals (PhD June 2017)
- Mladen Mikša (PhD January 2017)

Postdoctoral researchers:

- Ilario Bonacina (2015-2017)
- Jesús Giráldez Crú (2016-2017)
- Christoph Berkholz (Feb-Aug 2015)
- Massimo Lauria (2012-2015)

Currently advising 4 PhD students and hosting 4 postdocs (out of which 2 jointly)

## **Professional Service**

Workshops, PhD courses, et cetera:

- Main organizer of the workshop “Theory and Practice of Satisfiability Solving” at Casa Matemática Oaxaca (affiliated with BIRS), Aug 2018
- Main organizer of “Swedish Summer School in Computer Science” 2014-2018 ([s3cs.csc.kth.se](http://s3cs.csc.kth.se))
- Main organizer of the workshop “Proof Complexity” at Schloss Dagstuhl – Leibniz Center for Informatics, Jan-Feb 2018
- Main organizer of the workshop “Proof Complexity and Beyond” at Mathematisches Forschungsinstitut Oberwolfach, Aug 2017
- Member of organizing committee for the workshop “Theoretical Foundations of SAT Solving” at the Fields Institute, Aug 2016
- Member of program committee for the workshop “Beyond NP” affiliated with the 30th AAAI Conference on Artificial Intelligence (AAAI ‘16), Feb 2016
- Main organizer of the workshop “Theory and Practice of SAT Solving” at Schloss Dagstuhl – Leibniz Center for Informatics, Apr 2015
- Main organizer of the workshop “Theoretical Foundations of Applied SAT Solving” at the Banff International Research Station, Jan 2014

Conference committees:

- ACM Symposium on Theory of Computing (STOC) 2016
- Computational Complexity Conference (CCC) 2016
- Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM) 2013
- Conference on Theory and Applications of Satisfiability Testing (SAT) 2013-2016, 2018
- IEEE Conference on Computational Complexity (CCC) 2013

- International Computer Science Symposium in Russia (CSR) 2018
- International Joint Conference on Artificial Intelligence (IJCAI) 2018
- International Symposium on Theoretical Aspects of Computer Science (STACS) 2019

Scientific evaluations:

- Examination committee member for PhD thesis of Joel Larsson, Umeå University, June 2018
- Examination committee member for PhD thesis of Simon Ståhlberg, Linköping University, 2017
- External reviewer of research proposal for the Austrian Science Fund (FWF), 2016
- External reviewer of research proposal for the Swiss National Science Foundation (SNSF), 2016
- External reviewer for PhD thesis of Bangsheng Tang, Tsinghua University, Beijing, 2013

### **Commission of Trust**

2004-2007 President of the PhD Students' Council and PhD student representative in the Board and the Executive Group at the School of Computer Science and Communication, KTH

### **Awards**

2009 Ackermann Award for outstanding dissertation in Logic in Computer Science from the European Association for Computer Science Logic

2006 Danny Lewin Best Student Paper Award at the 38th ACM Symposium on Theory of Computing (STOC '06)

2006 The 2006 Meritorious Achievement Award at the School of Computer Science and Communication, KTH

### **Grants**

2017-2022 Consolidator Grant from the Swedish Research Council

2017-2020 Grant for Research Projects with High Scientific Potential from the Knut and Alice Wallenberg Foundation (co-PI)

2017-2019 Postdoctoral Scholarship Program in Mathematics Grant from the Knut and Alice Wallenberg Foundation

2013-2018 Breakthrough Research Grant from the Swedish Research Council

2012-2018 Starting Independent Researcher Grant from the European Research Council

2011-2014 Junior Researcher Position Grant (forskarassistenttjänst) from the Swedish Research Council

### **Selected Invited Presentations**

Mar 2017 Computational Complexity of Discrete Problems, Dagstuhl, Germany

Sep 2016 SAT and Interactions, Dagstuhl, Germany

Aug 2016 Theoretical Foundations of SAT Solving, Fields Institute, Toronto, Canada

May 2016 Proof complexity workshop during the Special Semester Program on Computational and Proof Complexity, St. Petersburg State University, Russia

Apr 2016 Workshop on Algorithms in Communication Complexity, Property Testing and Combinatorics, Skolkovo Institute of Science and Technology, Moscow, Russia

Apr 2016 Workshop on Theoretical Computer Science at the National Research University Higher School of Economics, Moscow, Russia

Feb 2016 Semidefinite and Matrix Methods for Optimization and Communication, Institute for Mathematical Sciences, Singapore

Oct 2014 Algorithms, Complexity and Machine Learning: A Tribute to Kurt Mehlhorn, Chalmers University of Technology, Göteborg, Sweden

Jul 2014	17th International Conference on Theory and Applications of Satisfiability Testing (SAT '14), Vienna, Austria
Jul 2014	Proof Complexity 2014, workshop at the Federated Logic Conference (FLoC '14), Vienna, Austria
May 2013	1st Symposium on Structure in Hard Combinatorial Problems, Vienna Center for Logic and Algorithms, Austria
Nov 2012	SAT Interactions, Dagstuhl, Germany
Sep 2012	Limits of Theorem Proving, IASI-CNR, Rome, Italy
Nov 2011	Mathematical Logic: Proof Theory, Constructive Mathematics, Oberwolfach, Germany
Oct 2011	Proof complexity workshop, Banff International Research Station, Banff, Canada
Jun 2011	Synergies in Lower Bounds, Aarhus University, Denmark
Jun 2011	Complexity and Finite Models (CMF '11), Paris, France
Mar 2011	Computational Complexity of Discrete Problems, Dagstuhl, Germany
Jul 2010	Propositional Proof Complexity: Theory and Practice, workshop at the Federated Logic Conference (FLoC '10), Edinburgh, UK
Jul 2010	International Workshop on Tractability, Microsoft Research, Cambridge, UK
Sep 2009	18th EACSL Conference on Computer Science Logic (CSL '09), Coimbra, Portugal
Aug 2009	Barriers in Computational Complexity, Princeton, USA
Sep 2008	Computational Complexity of Discrete Problems, Dagstuhl, Germany
May 2008	Physics of distributed information systems (PhysDIS), Stockholm, Sweden
Sep 2007	Fall School of Logic and Complexity, Třešť, Czech Republic
Apr 2006	New Directions in Proof Complexity, Isaac Newton Institute, Cambridge, UK
Mar 2006	Complexity of Boolean Functions, Dagstuhl, Germany

### **Peer-Reviewed Conference Publications**

*In computer science, the most important publication venues are conferences and not journals.*

- Albert Atserias, Ilario Bonacina, Susanna F. de Rezende, Massimo Lauria, Jakob Nordström, and Alexander Razborov. **Clique Is Hard on Average for Regular Resolution.** To appear in *Proceedings of the 50th Annual ACM Symposium on Theory of Computing (STOC '18)*, June 2018.
- Massimo Lauria, Jan Elffers, Jakob Nordström, and Marc Vinyals. **CNFgen: A Generator of Crafted CNF formulas.** In *Proceedings of the 20th International Conference on Theory and Applications of Satisfiability Testing (SAT '17)*, pages 464-473, August-September 2017.
- Massimo Lauria and Jakob Nordström. **Graph Colouring is Hard for Algorithms Based on Hilbert's Nullstellensatz and Gröbner Bases.** In *Proceedings of the 32nd Annual Computational Complexity Conference (CCC '17)*, pages 2:1-2:20, July 2017.
- Joël Alwen, Susanna F. de Rezende, Jakob Nordström, and Marc Vinyals. **Cumulative Space in Black-White Pebbling and Resolution.** In *Proceedings of the 8th Innovations in Theoretical Computer Science Conference (ITCS '17)*, January 2017.
- Susanna F. de Rezende, Jakob Nordström, and Marc Vinyals. **How Limited Interaction Hinders Real Communication (and What It Means for Proof and Circuit Complexity).** In *Proceedings of the 57th Annual IEEE Symposium on Foundations of Computer Science (FOCS '16)*, pages 295-304, October 2016.
- Christoph Berkholz and Jakob Nordström. **Supercritical Space-Width Trade-offs for Resolution.** In *Proceedings of the 43rd International Colloquium on Automata, Languages and Programming (ICALP '16)*, pages 57:1-57:14, July 2016.
- Jan Elffers, Jan Johannsen, Massimo Lauria, Thomas Magnard, Jakob Nordström, and Marc Vinyals. **Trade-offs Between Time and Memory in a Tighter Model of CDCL SAT Solvers.** In *Proceedings of the 19th International Conference on Theory and Applications of Satisfiability Testing (SAT '16)*, pages 160-176, July 2016.

- Christoph Berkholz and Jakob Nordström. **Near-Optimal Lower Bounds on Quantifier Depth and Weisfeiler-Leman Refinement Steps.** In *Proceedings of the 31st Annual ACM/IEEE Symposium on Logic in Computer Science (LICS '16)*, pages 267-276, July 2016.
- Siu Man Chan, Massimo Lauria, Jakob Nordström, and Marc Vinyals. **Hardness of Approximation in PSPACE and Separation Results for Pebble Games (Extended Abstract).** In *Proceedings of the 56th Annual IEEE Symposium on Foundations of Computer Science (FOCS '15)*, pages 466-485, October 2015.
- Massimo Lauria and Jakob Nordström. **Tight Size-Degree Bounds for Sums-of-Squares Proofs.** In *Proceedings of the 30th Annual Computational Complexity Conference (CCC '15)*, pages 448-466, June 2015.
- Mladen Mikša and Jakob Nordström. **A Generalized Method for Proving Polynomial Calculus Degree Lower Bounds.** In *Proceedings of the 30th Annual Computational Complexity Conference (CCC '15)*, pages 467-487, June 2015.
- Mladen Mikša and Jakob Nordström. **Long Proofs of (Seemingly) Simple Formulas.** In *Proceedings of the 17th International Conference on Theory and Applications of Satisfiability Testing (SAT '14)*, pages 121-137, July 2014.
- Albert Atserias, Massimo Lauria, and Jakob Nordström. **Narrow Proofs May Be Maximally Long.** In *Proceedings of the 29th Annual IEEE Conference on Computational Complexity (CCC '14)*, pages 286-297, June 2014.
- Yuval Filmus, Massimo Lauria, Mladen Mikša, Jakob Nordström, and Marc Vinyals. **From Small Space to Small Width in Resolution.** In *Proceedings of the 31st Symposium on Theoretical Aspects of Computer Science (STACS '14)*, pages 300-311, March 2014.
- Yuval Filmus, Massimo Lauria, Mladen Mikša, Jakob Nordström, and Marc Vinyals. **Towards an Understanding of Polynomial Calculus: New Separations and Lower Bounds (Extended Abstract).** In *Proceedings of the 40th International Colloquium on Automata, Languages and Programming (ICALP '13)*, pages 437-448, July 2013.
- Chris Beck, Jakob Nordström, and Bangsheng Tang. **Some Trade-off Results for Polynomial Calculus (Extended Abstract).** In *Proceedings of the 45th Annual ACM Symposium on Theory of Computing (STOC '13)*, pages 813-822, June 2013.
- Matti Järvisalo, Arie Matsliah, Jakob Nordström, and Stanislav Živný. **Relating Proof Complexity Measures and Practical Hardness of SAT.** In *Proceedings of the 18th International Conference on Principles and Practice of Constraint Programming (CP '12)*, pages 316-331, October 2012.
- Yuval Filmus, Massimo Lauria, Jakob Nordström, Neil Thapen, and Noga Ron-Zewi. **Space Complexity in Polynomial Calculus (Extended Abstract).** In *Proceedings of the 27th Annual IEEE Conference on Computational Complexity (CCC '12)*, pages 334-344, June 2012.
- Trinh Huynh and Jakob Nordström. **On the Virtue of Succinct Proofs: Amplifying Communication Complexity Hardness to Time-Space Trade-offs in Proof Complexity (Extended Abstract).** In *Proceedings of the 44th Annual ACM Symposium on Theory of Computing (STOC '12)*, pages 233-248, May 2012.
- Jakob Nordström and Alexander Razborov. **On Minimal Unsatisfiability and Time-Space Trade-offs for  $k$ -DNF Resolution.** In *Proceedings of the 38th International Colloquium on Automata, Languages and Programming (ICALP '11)*, pages 642-653, July 2011.
- Eli Ben-Sasson and Jakob Nordström. **Understanding Space in Proof Complexity: Separations and Trade-offs via Substitutions (Extended Abstract).** In *Proceedings of the 2nd Symposium on Innovations in Computer Science (ICS '11)*, pages 401-416, January 2011.
- Jakob Nordström. **On the Relative Strength of Pebbling and Resolution (Extended Abstract).** In *Proceedings of the 25th Annual IEEE Conference on Computational Complexity (CCC '10)*, pages 151-162, June 2010.
- Eli Ben-Sasson and Jakob Nordström. **Short Proofs May Be Spacious: An Optimal Separation of Space and Length in Resolution (Extended Abstract).** In *Proceedings of the 49th Annual IEEE Symposium on Foundations of Computer Science (FOCS '08)*, pages 709–718, October 2008.

- Jakob Nordström and Johan Håstad. **Towards an Optimal Separation of Space and Length in Resolution (Extended Abstract)**. In *Proceedings of the 40th Annual ACM Symposium on Theory of Computing (STOC '08)*, pages 701–710, May 2008.
- Jakob Nordström. **Narrow Proofs May Be Spacious: Separating Space and Width in Resolution (Extended Abstract)**. In *Proceedings of the 38th Annual ACM Symposium on Theory of Computing (STOC '06)*, pages 507–516, May 2006.

### Journal Publications

- Massimo Lauria and Jakob Nordström. **Tight Size-Degree Bounds for Sums-of-Squares Proofs**. *Computational Complexity*, volume 26, issue 4, pages 911–948, December 2017.
- Albert Atserias, Massimo Lauria, and Jakob Nordström. **Narrow Proofs May Be Maximally Long**. In *ACM Transactions on Computational Logic*, volume 17, issue 3, article 19, May 2016.
- Yuval Filmus, Massimo Lauria, Jakob Nordström, Noga Ron-Zewi, and Neil Thapen. **Space Complexity in Polynomial Calculus**. *SIAM Journal on Computing*, volume 44, issue 4, pages 1119-1153, August 2015.
- Yuval Filmus, Massimo Lauria, Mladen Mikša, Jakob Nordström, and Marc Vinyals. **From Small Space to Small Width in Resolution**. *ACM Transactions on Computational Logic*, volume 16, issue 4, article 28, July 2015.
- Jakob Nordström and Johan Håstad. **Towards an Optimal Separation of Space and Length in Resolution**. *Theory of Computing*, volume 9, article 14, pages 471-557, May 2013.
- Jakob Nordström. **On the Relative Strength of Pebbling and Resolution**. *ACM Transactions on Computational Logic*, volume 13, issue 2, article 16, April 2012.
- Jakob Nordström. **A Simplified Way of Proving Trade-off Results for Resolution**. *Information Processing Letters*, volume 109, number 18, pages 1030-1035, August 2009.
- Jakob Nordström. **Narrow Proofs May Be Spacious: Separating Space and Width in Resolution**. *SIAM Journal on Computing*, volume 39, issue 1, pages 59-121, May 2009. (Special issue on *STOC '06*.)

### Survey Articles

- Jakob Nordström. **On the Interplay Between Proof Complexity and SAT Solving**. *ACM SIGLOG News*, volume 2, number 3, pages 19-44, July 2015.
- Jakob Nordström. **A (Biased) Proof Complexity Survey for SAT Practitioners**. In *Proceedings of the 17th International Conference on Theory and Applications of Satisfiability Testing (SAT '14)*, pages 1-6, July 2014.
- Jakob Nordström. **Pebble Games, Proof Complexity, and Time-Space Trade-offs**. *Logical Methods in Computer Science*, volume 9, issue 3, article 15, September 2013.

### Manuscripts

- Jakob Nordström. **New Wine into Old Wineskins: A Survey of Some Pebbling Classics with Supplemental Results**. To appear in *Foundations and Trends in Theoretical Computer Science*. Manuscript in preparation, 2017.
- Arnab Bhattacharyya, Elena Grigorescu, Jakob Nordström, and Ning Xie. **On the Semantics of Local Characterizations for Linear-Invariant Properties**. Manuscript, 2011.

### Other Experience

- 1998-2011     Interpreter and translator between Russian and Swedish/English. Engaged as interpreter for among others HM the King of Sweden, the Prime Minister, and the Speaker of the Swedish Parliament
- 2002-2005     President of the Swedish Association of Military Interpreters (Befälsföreningen Militärtolkar, [www.militartolkar.org](http://www.militartolkar.org))

2001-2002 Secretary of the Swedish Association of Military Interpreters  
1994-1999 Artistic director of the vocal ensemble Collegium Vocale Stockholm  
1997/98 Compulsory national service as military interpreter at the Swedish Armed Forces Language Institute (Försvarets tolkskola). Graduated as the best student of the 1998 class