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Fedor V. Fomin · Stefan Kratsch ·
Erik Jan van Leeuwen (Eds.)

Treewidth, Kernels, and Algorithms

Essays Dedicated to Hans L. Bodlaender on the Occasion of His 60th Birthday

Springer

Editors
Fedor V. Fomin
University of Bergen
Bergen, Norway

Stefan Kratsch
Humboldt-University
Berlin, Germany

Erik Jan van Leeuwen
Utrecht University
Utrecht, The Netherlands

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Hans L. Bodlaender (photo by Ivar Pel)

Preface

This Festschrift celebrates the contributions of Hans L. Bodlaender on the occasion of his 60th birthday. Hans has made many transformative discoveries in algorithms research, complexity theory, and graph theory, as is evidenced in the articles of this volume.

The most well-known results by Hans come from his deep and thorough investigations into the *treewidth* of graphs. Intuitively defined as a measure of how close a graph resembles a tree, treewidth can be exploited by algorithms to solve many computational problems much faster on graphs of small treewidth than is possible in general. Finding efficient algorithms to determine whether a graph actually has small treewidth has fascinated Hans for many years. One of his defining contributions in the area is a linear-time algorithm for computing treewidth on graphs of bounded treewidth. This result has influenced the field so profoundly that it has become known as *Bodlaender's theorem*. It is a truly rare feat to have a named result, which speaks to the remarkable researcher that Hans is.

Hans' interest in treewidth proved a gateway to broader investigations into graph algorithms and graph theory. His deep knowledge and brilliant problem-solving abilities led to many diverse results in these areas and paved the way for many fellow researchers to pursue similar research directions. For example, he chairs the Steering Committee of the International Workshop on Graph-Theoretic Concepts in Computer Science and organized it twice. At the same time, Hans' enthusiasm inspired students of his lectures to explore this wondrous world and this led quite a few of those students to become researchers in graph algorithms themselves.

Treewidth as a graph parameter naturally steered Hans to the blossoming field of *parameterized algorithms and complexity*. A central notion in this field is that of a kernel: effectively a polynomial-time preprocessing heuristic with provable guarantees on the reduction in instance size that it achieves. Together with Rod Downey, Mike Fellows, and Danny Hermelin, Hans developed a framework to prove limitations of kernels, in that some problems do not admit kernels that reduce a problem to size polynomial in the parameter. This framework ushered in a new era in parameterized algorithms and guided many new investigations into the kernelization complexity of computational problems. The paper won Hans and his coauthors the EATCS-IPEC Nerode Prize 2014 for outstanding papers in the area of multivariate algorithmics.

The fact that Hans enjoys mathematical and computational puzzles naturally spills into the real world, where Hans enjoys puzzles and board games. Conversely, his interest in puzzles and board games led him to define and study new problems on the computational complexity of these games. Hence, Hans sees beautiful puzzles everywhere and excudes great joy solving them every day.

The Festschrift will be presented to Hans, as a surprise, at the workshop "Graph Decompositions: Small Width, Big Challenges" at the Lorentz Center in Leiden in

April 2020. It contains short personal contributions and surveys on the topics that have defined Hans' career.

Many congratulations on your birthday, Hans! Please enjoy this Festschrift and we hope for many years of beautiful science to come!

Finally, we wish to thank the people that made this volume possible. In particular, we thank all the authors for their wonderful contributions and for reviewing and proofreading. We also thank Alfred Hofmann and Anna Kramer at Springer for making the volume possible and for their support.

January 2020

Fedor V. Fomin
Stefan Kratsch
Erik Jan van Leeuwen

Laudations

Seeing Arboretum for the (partial k-) Trees

Stefan Arnborg[1] and Andrzej Proskurowski[2(✉)]

[1] Royal Institute of Technology, Stockholm, Sweden
[2] University of Oregon, Eugene, OR, USA
andrzej@cs.uoregon.edu

Abstract. The idea of applying a dynamic programming strategy to evaluating certain objective functions on trees is fairly straightforward. The road for this idea to develop into theories of width parameters has been not so straight. Hans Bodlaender has played a major role in the process of mapping out that road. In this sentimental journey, we will recount our collective road trip over the past decades.

Collaborating with Hans: Some Remaining Wonderments

Michael R. Fellows and Frances A. Rosamond[(✉)]

University of Bergen, 5020 Bergen, Norway
{michael.fellows,frances.rosamond}@uib.no

Abstract. This paper celebrates some family adventures, three concrete open problems and several research directions that have developed over our long collaboration.

Hans Bodlaender and the Theory of Kernelization Lower Bounds

Danny Hermelin

Department of Industrial Engineering and Management,
Ben-Gurion University of the Negev, Beersheba, Israel
hermelin@bgu.ac.il

Abstract. In this short letter I give a brief subjective account of my favorite result with Hans – our kernelization lower bounds framework. The purpose of this manuscript is not to give a formal introduction to this result and the area that spawned from it, nor is it meant to be a comprehensive survey of all related and relevant results. Rather, my aim here is to informally describe the history that lead to this result from a personal perspective, and to outline Hans's role in the development of this theory into what it is today.

Algorithms, Complexity, and Hans

Jan van Leeuwen

Department of Information and Computing Sciences, Utrecht University,
Princetonplein 5, 3584 CC Utrecht, The Netherlands
J.vanLeeuwen1@uu.nl

"The study of algorithms is at
the very heart of computer science"
Aho, Hopcroft, Ullman, [1], 1974, p. iii

Abstract. In this essay on the occasion of Hans Bodlaender's 60th birthday, we recount some of the early developments in the field in which Hans made his mark and of their context at Utrecht University.

Intelligent Cards for Excellent People

Gerard Tel

Utrecht University, Department of Computer Science

Abstract. We present a small, Excel-based application to print congratulation cards. The "card" automatically sorts the names of the senders, and includes the factorisation of the age of the celebrant (in days).

As a working example, we produce a card for a well-known scientist's 60th birthday. We also include some questions as food for thought.

Three levels of computing. For many people, the world of computing is a three storey building, but with an unusually long stair between the second and third floors.

At the ground floor, there is the world of *mental calculations*. Many people perform simple calculational tasks, like splitting a restaurant bill, without any supplies or devices. Few people can also perform more complicated tasks in this way, like extracting roots, and there is even a Mental Calculation World Cup[1] held every two years.

At the second floor, *electronic calculators* are a great help for many people to compute common life data, like energy consumption, holiday costs, etc. Scientific calculators can compute many functions, but are hand operated, so performing lengthy or repeated calculations can still be quite cumbersome.

The most complicated calculations, like finding treewidth or various graph optimalisations, are performed by *programmed computers* at the third floor of the calculations building. Of course, programming computers efficiently is an art mastered only by few (scientists and programmers).

In between: Excel. The gap between using a hand calculator and programming is quite large, both in the required skills and in the power of possible computations. Fortunately, there is a mechanism with intermediate difficulty and power, namely the use of *spreadsheets*, most notably, Excel. Excel offers the possibility to "program" computations in the form of formula's describing the content of each cell. The cell formula's make up a *model* of the computation, and this model allows to modify the inputs later, thus making it possible to reuse the computation.

Examples: Sorting and Factoring. Our Congratulation Card Generator[2] accepts information about the celebrant in the yellow cells on tab `YourData` and produces a personalized card on tab `Card`.

The tab `Bubble` implements Bubble Sort. It accepts (up to) ten strings or numbers in the yellow cells, and uses the names from `YourData` otherwise. The cells form a

[1] See https://en.wikipedia.org/wiki/Mental_calculator.

[2] See http://www.staff.science.uu.nl/~tel00101/Hans60.xlsx.

sorting network where, for example, cells C7 and D7 sort the values in C6 and D6 with a common conditional `IF(C6<D6;..;..)`.

All cells in our example are of *constant arity*, that is, each value is calculated from a constant number (two or three mostly) of other cells. Using more advanced Excel functions, of non-constant arity, allowing to express the minimum over a range of cells, InsertionSort or SelectionSort can also be "Excelled" quite easily, but we leave this as an exercise for the reader.

The tab `Factor` factorises a positive integer up to 1000000. The subsequent rows implement a *recursive formulation* of factoring, where the combination *(d, n)* represents the subproblem of factoring n without factors smaller than d. If d divides n, the next line will compute the subproblem (d, n/d) and the factor d is added to its result. If d exceeds the root of n, n is prime so n is its only factor. Otherwise, the next line solves the subproblem (d^+, n), with d^+ the next possible factor.

A challenge here is that Excel only works in rows that are pre-filled with formulas, so we need to know the *maximum number of rows* needed for any allowed integer (up to 1000000). Because either d increases by 2 or n reduces by a factor of 2 or more, the difference $\sqrt{n} - d$ decreases by at least 2 in most rows, so approximately $\frac{\sqrt{1000000}}{2}$ rows should be enough.

Care should be taken when testing this factoring capability. For a 60 year old scientist, his age in days is so close to e^{10}, that we expect his age to be prime roughly once in ten days. Of course, on such days the "factorisation" will only consist of the age; the first time this happens is exactly two weeks after the 60th birthday. The number of factors reaches a temporary peak five days after the birthday.

The card prototype. The card described in this short article is available for download[3]. Apart from changing the data on which the card is based, it will change from day to day anyways because of the dependence on the addressee's age.

[3] See, again, http://www.staff.science.uu.nl/~tel00101/Hans60.xlsx.

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Short Contributions

Surveys

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Curriculum Vitae Hans L. Bodlaender

Personal Information

Name:	Hans Leo Bodlaender
Born:	April 21, 1960 in Bennekom, The Netherlands
Married to:	Brigitte J. Bodlaender-Peters
Children:	Marijke, Wim, and Annefleur

Education

1986	Ph.D. in computer science, Utrecht University
1983	Doctoral degree (equiv. M.Sc.) in mathematics, Utrecht University
1981	Candidate degree (equiv. B.Sc.) in mathematics, Utrecht University

Employment

2014 –	full professor *Algorithms and Complexity*, Department of Information and Computing Sciences, Utrecht University (part time until 2018, full time since)
2014 – 2018	full professor *Network Algorithms*, Department of Mathematics and Computer Science, Eindhoven University of Technology (part time)
2003 – 2014	associate professor, Institute of Information and Computing Sciences, Utrecht University
1987 – 2003	assistant professor, Department of Computer Science, Utrecht University
1987	postdoctoral fellow, Department of Computer Science, Massachusetts Institute of Technology
1983 – 1987	research assistant, Department of Computer Science, Utrecht University

Prizes

2014	EATCS-IPEC Nerode Prize 2014 for outstanding papers in the area of multivariate algorithmics, for the paper *On problems without polynomial kernels* with Rodney G. Downey, Michael R. Fellows and Danny Hermelin

in Journal of Computer and System Sciences, 2009 (joint with *Infeasibility of instance compression and succinct PCPs for NP* by Lance Fortnow and Rahul Santhanam in Journal of Computer and System Sciences, 2011)

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85. Hans L. Bodlaender and Dimitrios M. Thilikos. Computing small search numbers in linear time. Technical Report UU-CS-1998-05, Department of Information and Computing Sciences, Utrecht University, 1998.
86. Hans Zantema and Hans L. Bodlaender. Sizes of decision tables and decision trees. Technical Report UU-CS-1999-31, Department of Information and Computing Sciences, Utrecht University, 1999.
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89. Dimitrios M. Thilikos and Hans L. Bodlaender. Constructive linear time algorithms for branchwidth. Technical Report UU-CS-2000-38, Department of Information and Computing Sciences, Utrecht University, 2000.
90. Hans L. Bodlaender, Richard B. Tan, and Jan van Leeuwen. Finding a delta-regular supergraph of minimum order. Technical Report UU-CS-2000-29, Department of Information and Computing Sciences, Utrecht University, 2000.
91. Jochen Alber, Hans L. Bodlaender, Henning Fernau, and Rolf Niedermeier. Fixed parameter algorithms for planar dominating set. Technical Report UU-CS-2000-28, Department of Information and Computing Sciences, Utrecht University, 2000.
92. Hans L. Bodlaender. Necessary edges in k-chordalizations of graphs. Technical Report UU-CS-2000-27, Department of Information and Computing Sciences, Utrecht University, 2000.
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94. Dimitrios M. Thilikos, Maria J. Serna, and Hans L. Bodlaender. A constructive linear time algorithm for small cutwidth. Technical Report UU-CS-2000-24, Department of Information and Computing Sciences, Utrecht University, 2000.
95. Hans L. Bodlaender and Fedor V. Fomin. Approximation of pathwidth of outerplanar graphs. Technical Report UU-CS-2000-23, Department of Information and Computing Sciences, Utrecht University, 2000.

96. Arie M.C.A. Koster, Hans L. Bodlaender, and Stan P. M. van Hoesel. Treewidth: Computational experiments. Technical Report UU-CS-2001-49, Department of Information and Computing Sciences, Utrecht University, 2001.
97. Hans L. Bodlaender and Udi Rotics. Computing the treewidth and the minimum fill-in with the modular decomposition. Technical Report UU-CS-2001-22, Department of Information and Computing Sciences, Utrecht University, 2001.
98. Hans L. Bodlaender, Michael J. Dinneen, and Bakhadyr Khoussainov. Relaxed update and partition network games. Technical Report UU-CS-2001-15, Department of Information and Computing Sciences, Utrecht University, 2001.
99. Hans L. Bodlaender. A generic NP-hardness proof for a variant of graph coloring. Technical Report UU-CS-2001-08, Department of Information and Computing Sciences, Utrecht University, 2001.
100. Dimitrios M. Thilikos, Maria J. Serna, and Hans L. Bodlaender. A polynomial algorithm for the cutwidth of bounded degree graphs with small treewidth. Technical Report UU-CS-2001-04, Department of Information and Computing Sciences, Utrecht University, 2001.
101. Frank van den Eijkhof, Hans L. Bodlaender, and Arie M.C.A. Koster. Safe reduction rules for weighted treewidth. Technical Report UU-CS-2002-051, Department of Information and Computing Sciences, Utrecht University, 2002.
102. Hans L. Bodlaender, Michael R. Fellows, and Dimitrios M. Thilikos. Derivation of algorithms for cutwidth and related graph layout problems. Technical Report UU-CS-2002-032, Department of Information and Computing Sciences, Utrecht University, 2002.
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104. Hans L. Bodlaender and Fedor V. Fomin. Tree decompositions with small cost. Technical Report UU-CS-2002-001, Department of Information and Computing Sciences, Utrecht University, 2002.
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106. Hans L. Bodlaender and Gerard Tel. Rectilinear graphs and angular resolution. Technical Report UU-CS-2003-033, Department of Information and Computing Sciences, Utrecht University, 2003.
107. Hans L. Bodlaender and Arie M. C. A. Koster. Safe separators for treewidth. Technical Report UU-CS-2003-027, Department of Information and Computing Sciences, Utrecht University, 2003.
108. Hans L. Bodlaender, Arie M. C. A. Koster, and Frank van den Eijkhof. Pre-processing rules for triangulation of probabilistic networks. Technical Report UU-CS-2003-001, Department of Information and Computing Sciences, Utrecht University, 2003.
109. Alexander Grigoriev and Hans L. Bodlaender. Algorithms for graphs embeddable with few crossings per edge. Technical Report UU-CS-2004-058, Department of Information and Computing Sciences, Utrecht University, 2004.
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113. Emgad H. Bachoore and Hans L. Bodlaender. New upper bound heuristics for treewidth. Technical Report UU-CS-2004-036, Department of Information and Computing Sciences, Utrecht University, 2004.
114. Hans L. Bodlaender, Arie M. C. A. Koster, and Thomas Wolle. Contraction and treewidth lower bounds. Technical Report UU-CS-2004-034, Department of Information and Computing Sciences, Utrecht University, 2004.
115. Hans L. Bodlaender and Thomas Wolle. Contraction degeneracy on cographs. Technical Report UU-CS-2004-031, Department of Information and Computing Sciences, Utrecht University, 2004.
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118. Hans L. Bodlaender and Fedor V. Fomin. Equitable colorings of bounded treewidth graphs. Technical Report UU-CS-2004-010, Department of Information and Computing Sciences, Utrecht University, 2004.
119. Hans L. Bodlaender and Thomas Wolle. A note on the complexity of network reliability problems. Technical Report UU-CS-2004-001, Department of Information and Computing Sciences, Utrecht University, 2004.
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122. Irit Katriel and Hans L. Bodlaender. Online topological ordering. Technical Report UU-CS-2005-011, Department of Information and Computing Sciences, Utrecht University, 2005.
123. Hans L. Bodlaender, Leizhen Cai, Jianer Chen, Michael R. Fellows, Jan Arne Telle, and Dániel Marx. Open problems in parameterized and exact computation - IWPEC 2006. Technical Report UU-CS-2006-052, Department of Information and Computing Sciences, Utrecht University, 2006.
124. Hans L. Bodlaender. A cubic kernel for feedback vertex set. Technical Report UU-CS-2006-042, Department of Information and Computing Sciences, Utrecht University, 2006.
125. Hans L. Bodlaender. Treewidth: Characterizations, applications, and computations. Technical Report UU-CS-2006-041, Department of Information and Computing Sciences, Utrecht University, 2006.
126. Hans L. Bodlaender, Fedor V. Fomin, Arie M. C. A. Koster, Dieter Kratsch, and Dimitrios M. Thilikos. On exact algorithms for treewidth. Technical Report UU-CS-2006-032, Department of Information and Computing Sciences, Utrecht University, 2006.

127. Hans L. Bodlaender and Dieter Kratsch. An exact algorithm for graph coloring with polynomial memory. Technical Report UU-CS-2006-015, Department of Information and Computing Sciences, Utrecht University, 2006.
128. Emgad Bachoore and Hans L. Bodlaender. Weighted treewidth: Algorithmic techniques and results. Technical Report UU-CS-2006-013, Department of Information and Computing Sciences, Utrecht University, 2006.
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132. Erwin M. Bakker, Hans L. Bodlaender, Richard B. Tan, and Jan van Leeuwen. Interval routing and minor-monotone graph parameters. Technical Report UU-CS-2006-001, Department of Information and Computing Sciences, Utrecht University, 2006.
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144. Hans L. Bodlaender, Erik D. Demaine, Michael R. Fellows, Jiong Guo, Danny Hermelin, Daniel Lokshtanov, Moritz Müller, Venkatesh Raman, Johan M.M. van Rooij, and Frances A. Rosamond. Open problems in parameterized and exact computation - IWPEC 2008. Technical Report UU-CS-2008-017, Department of Information and Computing Sciences, Utrecht University, 2008.
145. Hans L. Bodlaender, Richard B. Tan, Thomas C. van Dijk, and Jan van Leeuwen. Integer maximum flow in wireless sensor networks with energy constraint. Technical Report UU-CS-2008-005, Department of Information and Computing Sciences, Utrecht University, 2008.
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148. Hans L. Bodlaender, Fedor V. Fomin, Arie M. C. A. Koster, Dieter Kratsch, and Dimitrios M. Thilikos. A note on exact algorithms for vertex ordering problems on graphs. Technical Report UU-CS-2009-023, Department of Information and Computing Sciences, Utrecht University, 2009.
149. Johan Kwisthout and Hans L. Bodlaender. Conditional lower bounds on the complexity of probabilistic inference. Technical Report UU-CS-2009-018, Department of Information and Computing Sciences, Utrecht University, 2009.
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151. Hans L. Bodlaender, Fedor V. Fomin, Daniel Lokshtanov, Eelko Penninkx, Saket Saurabh, and Dimitrios M. Thilikos. (Meta) Kernelization. *CoRR*, abs/0904.0727, 2009.
152. Hans L. Bodlaender, Kyohei Kozawa, Takayoshi Matsushima, and Yota Otachi. Spanning tree congestion of k-outerplanar graphs. Technical Report UU-CS-2010-027, Department of Information and Computing Sciences, Utrecht University, 2010.
153. Hans L. Bodlaender and Johan M. M. van Rooij. Exact algorithms for intervalizing colored graphs. Technical Report UU-CS-2010-024, Department of Information and Computing Sciences, Utrecht University, 2010.
154. Hans L. Bodlaender and Arie M. C. A. Koster. Treewidth computations II. lower bounds. Technical Report UU-CS-2010-022, Department of Information and Computing Sciences, Utrecht University, 2010.
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156. Johan M. M. van Rooij, Marcel E. van Kooten Niekerk, and Hans L. Bodlaender. Partitioning sparse graphs into triangles: Relations to exact satisfiability and very fast exponential time algorithms. Technical Report UU-CS-2010-005, Department of Information and Computing Sciences, Utrecht University, 2010.

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158. Bart M. P. Jansen and Hans L. Bodlaender. Vertex cover kernelization revisited: Upper and lower bounds for a refined parameter. *CoRR*, abs/1012.4701, 2010.
159. Hans L. Bodlaender and Dieter Kratsch. Exact algorithms for Kayles. Technical Report UU-CS-2011-003, Department of Information and Computing Sciences, Utrecht University, 2011.
160. Hans L. Bodlaender, Bart M. P. Jansen, and Stefan Kratsch. Preprocessing for treewidth: A combinatorial analysis through kernelization. *CoRR*, abs/1104.4217, 2011.
161. Hans L. Bodlaender, Bart M. P. Jansen, and Stefan Kratsch. Kernel bounds for path and cycle problems. *CoRR*, abs/1106.4141, 2011.
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164. Linda C. van der Gaag, Hans L. Bodlaender, and Ad Feelders. Monotonicity in Bayesian networks. *CoRR*, abs/1207.4160, 2012.
165. Hans L. Bodlaender, Bart M. P. Jansen, and Stefan Kratsch. Kernel bounds for structural parameterizations of pathwidth. *CoRR*, abs/1207.4900, 2012.
166. Hans L. Bodlaender, Marek Cygan, Stefan Kratsch, and Jesper Nederlof. Solving weighted and counting variants of connectivity problems parameterized by treewidth deterministically in single exponential time. *CoRR*, abs/1211.1505, 2012.
167. Hans L. Bodlaender, Arie M. C. A. Koster, Frank van den Eijkhof, and Linda C. van der Gaag. Pre-processing for triangulation of probabilistic networks. *CoRR*, abs/1301.2256, 2013.
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169. Stefan Fafianie, Hans L. Bodlaender, and Jesper Nederlof. Speeding-up dynamic programming with representative sets - an experimental evaluation of algorithms for Steiner Tree on tree decompositions. *CoRR*, abs/1305.7448, 2013.
170. Hans L. Bodlaender and Marc J. van Kreveld. Google scholar makes it hard - The complexity of organizing one's publications. *CoRR*, abs/1410.3820, 2014.
171. Tom C. van der Zanden and Hans L. Bodlaender. PSPACE-completeness of Bloxorz and of games with 2-buttons. *CoRR*, abs/1411.5951, 2014.
172. Hans L. Bodlaender, Endre Boros, Pinar Heggernes, and Dieter Kratsch. Open problems of the lorentz workshop, "enumeration algorithms using structure". Technical Report UU-CS-2015-016, Department of Information and Computing Sciences, Utrecht University, 2015.
173. Lars Jaffke and Hans L. Bodlaender. MSOL-definability equals recognizability for Halin graphs and bounded degree k-outerplanar graphs. *CoRR*, abs/1503.01604, 2015.
174. Chiel B. Ten Brinke, Frank J. P. van Houten, and Hans L. Bodlaender. Practical algorithms for linear boolean-width. *CoRR*, abs/1509.07687, 2015.
175. Lars Jaffke and Hans L. Bodlaender. Definability equals recognizability for k-outerplanar graphs. *CoRR*, abs/1509.08315, 2015.
176. Hans L. Bodlaender and Jesper Nederlof. Subexponential time algorithms for finding small tree and path decompositions. *CoRR*, abs/1601.02415, 2016.
177. Hans L. Bodlaender and Tom C. van der Zanden. Improved lower bounds for graph embedding problems. *CoRR*, abs/1610.09130, 2016.

178. Mark de Berg, Hans L. Bodlaender, and Sándor Kisfaludi-Bak. The homogeneous broadcast problem in narrow and wide strips. *CoRR*, abs/1705.01465, 2017.
179. Jelco M. Bodewes, Hans L. Bodlaender, Gunther Cornelissen, and Marieke van der Wegen. Recognizing hyperelliptic graphs in polynomial time. *CoRR*, abs/1706.05670, 2017.
180. Tom C. van der Zanden and Hans L. Bodlaender. Computing treewidth on the GPU. *CoRR*, abs/1709.09990, 2017.
181. Federico D'Ambrosio, Gerard T. Barkema, and Hans L. Bodlaender. Optimal data structures for stochastic driven simulations. *CoRR*, abs/1802.02379, 2018.
182. Mark de Berg, Hans L. Bodlaender, Sándor Kisfaludi-Bak, Dániel Marx, and Tom C. van der Zanden. Framework for ETH-tight algorithms and lower bounds in geometric intersection graphs. *CoRR*, abs/1803.10633, 2018.
183. Johan M. M. van Rooij, Hans L. Bodlaender, Erik Jan van Leeuwen, Peter Rossmanith, and Martin Vatshelle. Fast dynamic programming on graph decompositions. *CoRR*, abs/1806.01667, 2018.
184. Mark de Berg, Hans L. Bodlaender, Sándor Kisfaludi-Bak, and Sudeshna Kolay. An ETH-tight exact algorithm for euclidean TSP. *CoRR*, abs/1807.06933, 2018.
185. Hans L. Bodlaender and Tom C. van der Zanden. On exploring temporal graphs of small pathwidth. *CoRR*, abs/1807.11869, 2018.
186. Hans L. Bodlaender, Marieke van der Wegen, and Tom C. van der Zanden. Stable divisorial gonality is in NP. *CoRR*, abs/1808.06921, 2018.
187. Hans L. Bodlaender, Benjamin A. Burton, Fedor V. Fomin, and Alexander Grigoriev. Knot diagrams of treewidth two. *CoRR*, abs/1904.03117, 2019.
188. Hans L. Bodlaender, Sudeshna Kolay, and Astrid Pieterse. Parameterized complexity of conflict-free graph coloring. *CoRR*, abs/1905.00305, 2019.
189. Hans L. Bodlaender, Lars Jaffke, and Jan Arne Telle. Typical sequences revisited - algorithms for linear orderings of series parallel digraphs. *CoRR*, abs/1905.03643, 2019.
190. Hans L. Bodlaender, Tesshu Hanaka, Yasuaki Kobayashi, Yusuke Kobayashi, Yoshio Okamoto, Yota Otachi, and Tom C. van der Zanden. Subgraph isomorphism on graph classes that exclude a substructure. *CoRR*, abs/1905.10670, 2019.

Program Committees

Chair: WG 2003, IWPEC 2006, ESA 2013 (track A), WG 2017, MFCS 2017.

Member: STACS 1993, WG 1996, CIAC 1997, WG 1997, SIROCCO 1997, WG 1998, WG 1999, ESA 1999, WG 2000, WG 2001, WG 2002, ISAAC 2002, WADS 2003, WG 2004, IWPEC 2004, WG 2005, ICALP 2005, AAIM 2006, SOFSEM 2007, WG 2007, AAIM 2007, UAI 2007, COCOA 2008, WG 2009, TAMC 2009, IWPEC 2009, SWAT 2010, ESA 2010, TAMC 2010, IPEC 2011, WALCOM 2012, STACS 2012, APEX 2012, WG 2012, IPEC 2014, FAW 2014, WG 2014, WALCOM 2015, ICALP 2015, FAW 2015, LATA 2016, WG 2016, SOFSEM 2017, LICS 2018, WALCOM 2019, WG 2019, TAMC 2019, WALCOM 2019, SODA 2019.

Editorships

2014 –	Discrete Algorithms
1997 –	Acta Cybernetica
1997 –	Discrete Mathematics and Theoretical Computer Science

2008 – 2012	Information and Computation
2000	Algorithmica, guest editor special issue

Ph.D. Students

1993	A.J.J. (Ton) Kloks (co-promotor; promotor: Jan van Leeuwen)
1993	Goos Kant (co-promotor; promotor: Jan van Leeuwen)
1997	Babette L.E. de Fluiter (co-promotor; promotor: Jan van Leeuwen)
2005	Thomas Wolle (co-promotor; promotor: Jan van Leeuwen)
2009	Johan H.P. Kwisthout (co-promotor; other co-promoter: Gerard Tel; promotor: Jan van Leeuwen and Linda C. van der Gaag)
2011	Johan M.M. van Rooij (co-promotor; promotor: Jan van Leeuwen)
2013	Bart M.P. Jansen (co-promotor; promotor Jan van Leeuwen)
2019	Tom C. van der Zanden
2019	Sándor Kisfaludi-Bak (other promotor: Mark T. de Berg)

Research Guests and Postdocs

1996 – 1998	Dimitrios M. Thilikos, postdoc
1996 – 1997	Koichi Yamazaki, postdoc
2005 – 2011	Eelko Penninkx
2009	Marc Comas, research visit
2009	Yota Otachi, research visit
2009	Manu Basavaraju, research visit
2011	Zhang Wenyan, research visit
2010 – 2012	Stefan Kratsch, postdoc
2012 – 2014	Jesper Nederlof, postdoc
2014	O-joung Kwon and Jisu Jeong, research visit
2016	Tesshu Hanaka, research visit
2019	Lars Jaffke, research visit
2019	Hisao Tamaki, sabbatical
2019	Toshiki Saitoh, sabbatical

Invited Lectures

1992	7th International Meeting of Young Computer Scientists, Smolenice
1997	International Symposium on Mathematical Foundations of Computer Science (MFCS)
2000	6th International Conference on Graph Theory, Marseille
2005	31st Annual Conference on Current Trends in Theory and Practice of Informatics (SOFSEM)

2006	32nd International Workshop on Graph-Theoretic Concepts in Computer Science (WG)
2007	14th International Colloquium on Structural Information and Communication Complexity (SIROCCO)
2008	Workshop in Graph Decomposition: Theoretical, Algorithmic and Logical Aspects, CIRM, Marseille
2009	4th International Workshop on Parameterized and Exact Computation (IWPEC), Copenhagen
2011	Theory Day of the Nederlandse Vereniging voor Theoretische Informatica (NVTI), Utrecht
2011	6th International Symposium on Parameterized and Exact Computation (IPEC), tutorial
2011	5th Workshop on Graph Classes and Width Parameters (GROW), Daejeon
2013	European Conferences on Symbolic and Quantitative Approaches to Reasoning with Uncertainty (ESQARU), Utrecht, tutorial
2014	9th International Workshop on Parameterized and Exact Computation (IWPEC), Wrocław
2016	ICT-OPEN, Apeldoorn
2017	Networks Day, Eindhoven
2019	19th Haifa Workshop on Interdisciplinary Applications of Graphs, Combinatorics and Algorithms, Haifa

Organizers

2010	WORKER 2010: Workshop on Kernelization, with Fedor V. Fomin and Saket Saurabh, Lorentz Center, Leiden
2014	Workshop “Graph modification problems”, with Pinar Heggernes and Daniel Lokshtanov, Schloss Dagstuhl
2015	Workshop “Enumeration Algorithms using Structure”, with Endre Boros, Pinar Heggernes, and Dieter Kratsch, Lorentz Center, Leiden
2016	Workshop “Fixed Parameter Computational Geometry”, with Mark de Berg, Benjamin Burton, and Christian Knauer, Lorentz Center, Leiden
2018	Workshop “Fixed Parameter Computational Geometry”, with Mark de Berg, Benjamin Burton, and Christian Knauer, Lorentz Center, Leiden
2018	NWO-JSPS joint seminar “Computations on Networks with a Tree-Structure: From Theory to Practice”, Eindhoven
2020	Workshop “Fixed Parameter Computational Geometry”, with Mark de Berg, Benjamin Burton, and Christian Knauer, Lorentz Center, Leiden

Grants

1989 – 1993	NWO-SION grant "Algorithms for tree-structured graphs"
1993 – 1997	NWO-SION grant "Algorithms for tree-structured graphs and their practical aspects"
1996 – 1997	Japan government grant for postdoc Koichi Yamazaki
1996 – 1998	EC Human Mobility Capital grant for postdoc Dimitrios M. Thilikos
2001 – 2006	NWO grant "Treewidth and Combinatorial Optimization" (with Stan van Hoesel)
2005 – 2009	NWO grant "Algorithmic Complexity of Probabilistic Networks"
2009 – 2013	NWO grant "KERNELS: Combinatorial Analysis of Data Reduction"
2012 – 2014	NWO grant "Space and Time Efficient Structural Improvements of Dynamic Programming Algorithms"

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