

# Curriculum Vitae for Mikkel Thorup (generated February 28, 2022)

Birth: Copenhagen, Denmark, February 13th, 1965.  
Citizenships: Denmark and United States of America.

## Education

- 1986–1990 *Technical University of Denmark*. Ba.Sc+M.Sc. Thesis work supervised by Prof. D. Bjørner. Degree awarded October 31, 1990.
- 1989–1990 *University of Oxford*. Visiting student at the Computing Laboratory with Prof. C.A.R. Hoare as supervisor.
- 1990–1993 *University of Oxford*. Doctor of Philosophy in the Faculty of Mathematical Sciences. Supervised by Dr. W.F. McColl (Computing Laboratory), Dr. C. McDiarmid (Dept. of Statistics), and partly by Prof. D. Welsh (Dept. of Mathematics). Degree awarded March 5, 1994.
- 1992–1993 *DIMACS*. Visiting Research Fellow during special year in Combinatorial Optimization organized by Prof. L. Lovazs and Prof. P. Seymour, invited by P. Seymour. I was the only Research Fellow invited without a completed PhD.

## Employment

- 1993–1998 *University of Copenhagen*. Associate Professor. The last half year, I was a visiting research fellow at *Massachusetts Institute of Technology (MIT)*.
- 1998–2013 *AT&T Labs Research*. Lead Member of Technical Staff.
- Since 2013 *University of Copenhagen*. Full Professor at Department of Computer Science (DIKU) and Head the Algorithms and Complexity Section.

## Honorary

- 1997 *Distinguished Visiting Professor at Max-Planck-Institut für Informatik*. Presented as a kind of award which included giving some award lectures.
- 2003 *AT&T Research Excellence Award*. Internal award.
- 2005 *Fellow of the ACM—for contributions to algorithms and data structures*. ACM is the main academic society of computer science, publishing most of the top journals. The ACM Fellows Program was established by the Council in 1993 to recognize and honor outstanding ACM members for their achievements in computer science and information technology and for their significant contributions to the mission of the ACM. The ACM Fellows serve as distinguished colleagues to whom the ACM and its members look for guidance and leadership as the world of information technology evolves. In 2005, 34 fellows were inducted for all of Computer Science.
- 2006 *Member of the Royal Danish Academy of Sciences and Letters*.
- 2010 *AT&T Fellow Honor—for outstanding innovation in algorithms, including advanced hashing and sampling techniques applied to AT&T's Internet traffic analysis and speech services*. AT&T annually acknowledges those individuals in its technical community who have made continual, outstanding and unique contributions to AT&T and the world through their technical and scientific achievements. These men and women are bestowed with the AT&T Fellows

Honor for making a great impact on the business and the scientific world. In 2010, AT&T gave three such honors.

- 2011 *Mathematical Association of America (MAA) Robbins Prize*. The prize is given once every three years to the author or authors of an outstanding paper in algebra, combinatorics, or discrete mathematics. Co-winner for [133]. *The papers describe an impressive result in discrete mathematics; the problem is easily understood and the arguments, despite their depth, are easily accessible to any motivated undergraduate.*
- 2015 *Villum Kann Rasmussen Annual Award for Technical and Scientific Research*. The biggest individual research prize in Denmark.
- 2021 *Fulkerson Prize*. Awarded jointly by the American Mathematical Society (AMS) and the Mathematical Optimization Society (MOS) once every third year for outstanding papers in discrete mathematics, including graph theory, networks, mathematical programming, applied combinatorics, applications of discrete mathematics to computer science, and related subjects. Co-winner for [111].
- 2021 *ACM STOC 20-Year Test of Time Award*. Co-winner for [213].

## Research funding

I worked as an industrial researchers for AT&T Labs—Research from 1998 to 2013, and in that period, I was not allowed to apply for any funding. Ample resources were provided internally. Since returning to Denmark in 2013, I have received the following funding as PI:

- “Center for Efficient Algorithms and Data Structures (EADS)”, Advanced Grant from the Danish Council for Independent Research under the Sapere Aude research career programme (“DFF topforsker”). It was 10.5 million DKK and ran 2013-2018.  
This grant facilitated my return to Denmark in 2013. It allowed me to start a center within algorithms and data structures, where I could start supervising and co-supervising 5 PhD students that were among the most successful in the world in my field. They are now all either doing start-ups or having faculty positions. One, Mathias B.T. Knudsen received the 2017 prize for the best PhD thesis in Science at the University of Copenhagen.
- Villum Kann Rasmussen Annual Award for Technical and Scientific Research (also mentioned above as a prize), awarded 2015. It is 5 million DKK and runs out in 2025. These are free money, not tied to any project plan, giving me the freedom to jump on any great opportunity passing by, e.g., I could instantly offer Vincent Cohen-Addad a PostDoc Fellowship that we, within a year, got replaced with a Marie Curie Postdoctoral Fellowship from the EU.
- “Basic Algorithms Research Copenhagen (BARC)”, Villum Investigator Grant, awarded in 2017. It is 39 million DKK and runs out in 2023. It involves core researchers from both the IT-University of Copenhagen and DIKU, and provides an ideal research environment for PhDs, PostDocs, and visiting international stars.

## Research funding panels

- ERC Consolidator Grant Panel (PE6) in 2015 and 2017.

## Other appointments

2001–2003 *IT-University of Copenhagen*. Member of Foresight Panel.

2009–2015 *Octoshape*. Member of Technical Advisory Board until the company got sold to Akamai.

2017–Now *ACM Fellows Committee*. Selection of new ACM Fellows.

## Research area

My main area of research is algorithms which is a main subarea of theoretical computer science, and of computer science in general. Let me emphasize that theory here means that we use the power of mathematics to understanding and develop algorithms with provably guarantees for all possible inputs. Many of the most important practical algorithms have their roots in theory, e.g., the PageRank algorithm behind Google. Indeed I got the AT&T Fellows Honor for my high industrial impact. More recently, Vimeo solved the bandwidth problem they had streaming video to 200 million customers by switching to one of my algorithms<sup>1</sup>. However, theory of computing is also an exiting new branch of mathematics developing new techniques that can address old challenges. My Robbins Prize from MAA was for solving a classic problem mentioned in text books of theoretical mechanics as far back as 1849.

## Students

While at University of Copenhagen in 1993-1998 I supervised the thesis work of 9 Master's students and 1 PhD student. My PhD student, Stephen Alstrup first became Associate Professor at the IT-University in Copenhagen. Then he became CEO for his upstart company Octoshape doing streaming algorithms, streaming content to more than 100 million customers before it got sold to Acamai for around \$100M (price secret). I was myself on the Technical Advisory Board for Octoshape. Since 2012 he has been a Full Professor at DIKU.

While at AT&T in 1998-2013, I could not have students, but I was mentor for Mihai Pătraşcu from MIT who was awarded The 2005 Outstanding Male Undergraduate Award by the Computing Research Association. After he finished his PhD at MIT, he joined my group at AT&T, continuing our productive collaboration. He is one of two co-winners of the 2012 EATCS Presburger Award for young scientists. Sadly he passed away in 2012.

Since I returned to DIKU in 2013 I have (co-)supervised to completion 7 PhD-students: Søren Dahlgaard, Mathias Bæk Tejs Knudsen, Eva Rotenberg, and Mikkel Abrahamsen that all finished in 2017, Jacob Holm who finished in 2018, and Anders Aamand and Maximilian Probst who finished in 2020. Mathias Bæk Tejs Knudsen received the 2017 prize for the best PhD thesis in Science at the University of Copenhagen. Since then, Søren Dahlgaard and Mathias Bæk Tejs Knudsen have co-founded a start-up Supwiz together with Stephen Alstrup, and they received the 2019 Grand Solution Prize from the Innovation Fund Denmark. Eva Rotenberg is now Assistant Professor at the Technical University of Denmark and Mikkel Abrahamsen and Jacob Holm have both become an Assistant Professors at DIKU. Anders Aamand is starting a PostDoc at MIT and Maximilian Probst is starting one in ETH. My current PhD students are Jakob Bæk Tejs Knudsen, Evangelos Kipouridis, and Jonas Klausen.

---

<sup>1</sup>A. Rodland. Improving load balancing with a new consistent-hashing algorithm. *Vimeo Engineering Blog*, Dec 19, 2016. <https://medium.com/vimeo-engineering-blog/improving-load-balancing-with-a-new-consistent-hashing-algorithm-9f1bd75709ed>

## Publication venues

To help the reader from a different field, let me briefly discuss the ranking of the relevant publication venues from an algorithms perspective.

**Conference publications** In most of computer science, selective refereed conference proceedings form the primary means of publications. My primary area is algorithms which is part of theoretical computer science.

The two top conferences are the general theory conferences *ACM Symposium on Theory of Computing (STOC)* and *IEEE Symposium on Foundations of Computer Science (FOCS)*. On the level just below these two topmost conferences, we have the European flagship *International Colloquium on Automata Languages, and Programming (ICALP)* and, specialized in algorithms, *ACM-SIAM Symposium on Discrete Algorithms (SODA)*.

I have published in several other areas of computer science, e.g., in the top conferences *SIGCOMM* and *INFOCOM* for Internet research. In total I have more than 100 papers in CORE A\*-ranked venues.

**Journal publications** We also publish in journals. The conference papers often have a page limit, which doesn't suffice for full proofs, and then it is important to also publish a complete paper in a journal. While conferences ensure quick and timely dissemination of ideas, journal publication often takes years and are of a more archival nature for the future. The *Journal of the ACM* is the flagship journal on principles of computing. The second best journal is *SIAM Journal of Computing*. Below these two top journals there are many good options such as the best specialized journals *ACM Transactions on Algorithms* (former *Journal of Algorithms*) and *Algorithmica* as well as general computer science journals such as *Information and Computation* and *Journal of Computer and Systems Sciences*.

## Editorial Boards

After many years of service, I quit from all editorial boards in 2018. Most journals aim for a maximal term of 5 years, but they kept asking me to continue. I quit to free up time for other things, e.g., my new BARC center.

- Associate Editor of *Journal of Discrete Algorithms* 1998-2004.
- Associate Editor of *Journal of Algorithms*<sup>2</sup> 1999–2004.
- Associate Editor of *ACM Transactions on Algorithms* 2004–2015.
- Associate Editor of *SIAM Journal on Computing* 2004-2018.
- Area Editor of Algorithms and Data Structures for *Journal of ACM* 2004–2018. Received an “Recognition of Service Award” for my long tenure with the journal.
- Associate Editor of *Theory of Computing* — an open access journal, 2005-2018.

## Program Committees

- The 29th Annual ACM Symposium on Theory of Computing (STOC), El Paso, Texas, May 4–6, 1997.

---

<sup>2</sup>Participated in the *J. Algorithms* editorial board resignation against high commercial pricing, creating *ACM Trans. Algorithms* instead.

- The 25th International Colloquium on Automata Languages, and Programming (ICALP), Aalborg, Denmark, July, 1998.
- The 24th International Symposium on Mathematical Foundations of Computer Science (MFCS), September 6–10, 1999, Szklarska Poreba, Polan
- The 34th Annual ACM Symposium on Theory of Computing (STOC), Montréal, Québec, Canada, May 19–21 2002.
- The 36th Annual ACM Symposium on Theory of Computing (STOC), Chicago, Illinois, USA, June 13–15 2004.
- The 46th Annual IEEE Symposium on Foundations of Computer Science (FOCS), Pittsburgh, USA, October 23–25, 2005
- The 39th Annual ACM Symposium on Theory of Computing (STOC), San Diego, CA, USA, June 11–13 2007.
- The 41st Annual ACM Symposium on Theory of Computing (STOC), Bethesda, MD, USA, May 31–June 2, 2009.
- The 51st Annual IEEE Symposium on Foundations of Computer Science (FOCS), Las Vegas, NV, USA, October 23–26, 2010.
- The 23rd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA), Kyoto, Japan, January 17–19, 2012.
- The 45th Annual ACM Symposium on Theory of Computing (STOC), Palo Alto, CA, USA, June 1–4, 2013.
- The 46h Annual ACM Symposium on Theory of Computing (STOC), New York, NY, USA, May 31–June 3, 2014.
- The 43rd International Colloquium on Automata Languages, and Programming (ICALP), Rome, Italy, 12–15 July, 2016.
- The 28th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA), Barcelona, Spain, January 16–19, 2017.
- **Program Committee Chair** for the 59th Annual IEEE Symposium on Foundations of Computer Science (FOCS), Paris, France, October 7-9, 2018.
- **Host and Local Chair** of Highlights of Algorithms (HALG) in 2019 in Copenhagen.

### Other Conference Committees

- **Host and Local Chair** of Highlights of Algorithms (HALG) in 2019 in Copenhagen.
- **Starting new conference** Since 2009, I have lobbied for the importance of **simple** algorithms at SODA. In 2018, I was in the group starting Symposium on Simplicity in Algorithms (SOSA), which since 2019 have been co-located with SODA, and been a huge success with the lowest accept rate of all conferences within theory of computing.

### Invited/keynote talks

As discussed above, in computer science, the primary talks are those selected for presentation the prestigious conferences with widely read proceedings. In addition, these conferences typically have 0-3 invited/keynote talks where experts review previously published material. Within the last couple of years, I have given such invited/keynote talks at the following conferences:

- Workshop on Big Data: Theoretical Foundations of Big Data, Rutgers, USA, October 2014.
- The 8th International Conference on Algorithms and Complexity (CIAC), Paris, France, May 2015.
- The 36th IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS), Chennai, India, December 2016.
- The 14th ACM SIGEVO Workshop on Foundations of Genetic Algorithms, Copenhagen, Denmark, January 2017.
- The 44th International Colloquium on Automata, Languages, and Programming (ICALP), Warsaw, Poland, July 2017.
- The 29th ACM-SIAM Symposium on Discrete Algorithms (SODA), New Orleans, USA, January 2018.

Of other distinguished talks, I gave an open lecture at the Simons Institute, Berkeley, December 2015.

## Publications

My H-index according to Google Scholar was 66 on December 31, 2021, with a total of 17,357 citations (Google Scholar works well in computer science because they include conferences that are our main means of publication). I have more than 100 distinct co-authors. In my field, we normally have *equal authorship*, as indicated by an alphabetic ordering of the authors.

- [1] Anders Aamand, Mikkel Abrahamsen, and Mikkel Thorup. Discs in curves of bounded convex curvature. *The American Mathematical Monthly*, 127(7):579–593, 2020.
- [2] Anders Aamand, Jakob Bæk Tejs Knudsen, Mathias Bæk Tejs Knudsen, Peter Michael Reichstein Rasmussen, and Mikkel Thorup. Fast hashing with strong concentration bounds. In *Proceedings of the 52nd Annual ACM SIGACT Symposium on Theory of Computing (STOC)*, pages 1265–1278, 2020.
- [3] Anders Aamand, Jakob Bæk Tejs Knudsen, and Mikkel Thorup. Load balancing with dynamic set of balls and bins. In *Proceedings of the 53rd Annual ACM SIGACT Symposium on Theory of Computing (STOC)*, pages 1262–1275, 2021.
- [4] Anders Aamand, Mathias Bæk Tejs Knudsen, and Mikkel Thorup. Power of  $d$  choices with simple tabulation. In *Proceedings of the 45th International Colloquium on Automata, Languages, and Programming (ICALP)*, pages 5:1–5:14, 2018.
- [5] Anders Aamand and Mikkel Thorup. Non-empty bins with simple tabulation hashing. In *Proceedings of the 30th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 2498–2512, 2019.
- [6] Ittai Abraham, Cyril Gavoille, Dahlia Malkhi, Noam Nisan, and Mikkel Thorup. Compact name-independent routing with minimum stretch. In *Proceedings of the 16th ACM Symposium on Parallel Algorithms (SPAA)*, pages 20–24, 2004.
- [7] Ittai Abraham, Cyril Gavoille, Dahlia Malkhi, Noam Nisan, and Mikkel Thorup. Compact name-independent routing with minimum stretch. *ACM Transactions on Algorithms*, 4(3):Article 37, 2008. Announced at SPAA’04.

- [8] Mikkel Abrahamsen, Anna Adamaszek, Karl Bringmann, Vincent Cohen-Addad, Mehran Mehr, Eva Rotenberg, Alan Roytman, and Mikkel Thorup. Fast fencing. In *Proceedings of the 50th ACM Symposium on Theory of Computing (STOC)*, pages 564–573, 2018.
- [9] Mikkel Abrahamsen and Mikkel Thorup. Finding the maximum subset with bounded convex curvature. In *Proceedings of the 32nd International Symposium on Computational Geometry (SoCG)*, Leibniz International Proceedings in Informatics (LIPIcs), pages 4:1–4:17, 2016.
- [10] Richa Agarwala, Vineet Bafna, Martin Farach, Babu Narayanan, Mike Paterson, and Mikkel Thorup. On the approximability of numerical taxonomy. In *Proceedings of the 7th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 365–372, 1996. Covered by [11].
- [11] Richa Agarwala, Vineet Bafna, Martin Farach, Babu Narayanan, Mike Paterson, and Mikkel Thorup. On the approximability of numerical taxonomy (fitting distances by tree metrics). *SIAM Journal on Computing*, 28(3):1073 – 1085, 1999. Announced at SODA’96.
- [12] Noga Alon, Nick Duffield, Carsten Lund, and Mikkel Thorup. Estimating arbitrary subset sums with few probes. In *Proceedings of the 24th Annual ACM Symposium on Principles of Database Systems (PODS)*, pages 317–325, 2005.
- [13] Stephen Alstrup, Inge Li Gørtz, Theis Rauhe, Mikkel Thorup, and Uri Zwick. Union-find with constant time deletions. In *Proceedings of the 32th International Colloquium on Automata Languages, and Programming (ICALP)*, LNCS 3580, pages 78–89, 2005. Covered by [14].
- [14] Stephen Alstrup, Inge Li Gørtz, Theis Rauhe, Mikkel Thorup, and Uri Zwick. Union-find with constant time deletions. *ACM Transactions on Algorithms*, 11(1):Article 6, 2014. Announced at ICALP’05.
- [15] Stephen Alstrup, Dov Harel, Peter W. Lauridsen, and Mikkel Thorup. Dominators in linear time. *SIAM Journal on Computing*, 28(6):2117–2132, 1999.
- [16] Stephen Alstrup, Jacob Holm, Kristian de Lichtenberg, and Mikkel Thorup. Minimizing diameters of dynamic trees. In *Proceedings of the 24th International Colloquium on Automata Languages, and Programming (ICALP)*, LNCS 1256, pages 270–280, 1997.
- [17] Stephen Alstrup, Jacob Holm, Kristian de Lichtenberg, and Mikkel Thorup. Direct routing on trees. In *Proceedings of the 9th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 342–349, 1998.
- [18] Stephen Alstrup, Jacob Holm, and Mikkel Thorup. Maintaining center and median in dynamic trees. In *Proceedings of the 7th Scandinavian Workshop on Algorithms Theory (SWAT)*, LNCS 1851, pages 46–56, 2000.
- [19] Stephen Alstrup, Jacob Holm, Mikkel Thorup, and Kristian de Lichtenberg. Maintaining information in fully dynamic trees with top trees. *ACM Transactions on Algorithms*, 1(2):243–264, 2005.
- [20] Stephen Alstrup, Thore Husfeldt, Theis Rauhe, and Mikkel Thorup. Black box for constant-time insertion in priority queues (note). *ACM Transactions on Algorithms*, 1(1):102–106, 2005.
- [21] Stephen Alstrup, Haim Kaplan, Mikkel Thorup, and Uri Zwick. Adjacency labeling schemes and induced-universal graphs. In *Proceedings of the 47th ACM Symposium on Theory of Computing (STOC)*, pages 625–634, 2015.

- [22] Stephen Alstrup, Peter W. Lauridsen, Peer Sommerlund, and Mikkel Thorup. Finding cores of limited length. In *Proceedings of the 5th International Workshop on Algorithms and Data Structures (WADS), LNCS 1272*, pages 45–54, 1997.
- [23] Stephen Alstrup, Peter W. Lauridsen, and Mikkel Thorup. Generalized dominators for structured programs. In *Proceedings of the 3rd Static Analysis Symposium (SAS), LNCS 1145*, pages 42–51, 1996. Covered by [24].
- [24] Stephen Alstrup, Peter W. Lauridsen, and Mikkel Thorup. Generalized dominators for structured programs. *Algorithmica*, 27(3):244–253, 2000. Announced at STACS’96.
- [25] Stephen Alstrup, Jens P. Secher, and Mikkel Thorup. Word encoding tree connectivity works. In *Proceedings of the 11th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 498–499, 2000.
- [26] Stephen Alstrup and Mikkel Thorup. Optimal pointer algorithm for finding nearest common ancestors in dynamic trees. In *Proceedings of the 5th Scandinavian Workshop on Algorithm Theory (SWAT), LNCS 1097*, pages 212–222, 1996. Covered by [27].
- [27] Stephen Alstrup and Mikkel Thorup. Optimal pointer algorithm for finding nearest common ancestors in dynamic trees. *Journal of Algorithms*, 35:169–188, 2000. Announced at SWAT’96.
- [28] Aysegül Altin, Bernard Fortz, Mikkel Thorup, and Hakan Ümit. Intra-domain traffic engineering with shortest path routing protocols. *4OR*, 7(4):301–335, 2009.
- [29] Aysegül Altin, Bernard Fortz, Mikkel Thorup, and Hakan Ümit. Intra-domain traffic engineering with shortest path routing protocols. *Annals of Operations Research*, 204(1):56–95, 2013. Invited paper.
- [30] Arne Andersson, Peter Bro Miltersen, Søren Riis, and Mikkel Thorup. Static dictionaries on  $AC^0$  RAMs: Query time  $\Theta(\sqrt{\log n / \log \log n})$  is necessary and sufficient. In *Proceedings of the 37th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 441–450, 1996.
- [31] Arne Andersson, Peter Bro Miltersen, and Mikkel Thorup. Fusion trees can be implemented with  $AC^0$  instructions only. *Theoretical Computer Science*, 215(1-2):337–344, 1999.
- [32] Arne Andersson and Mikkel Thorup. Tight(er) worst-case bounds on dynamic searching and priority queues. In *Proceedings of the 32nd ACM Symposium on the Theory of Computing (STOC)*, pages 335–342, 2000. Covered by [34].
- [33] Arne Andersson and Mikkel Thorup. Dynamic string searching. In *Proceedings of the 12th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 307–308, 2001. Covered by [34].
- [34] Arne Andersson and Mikkel Thorup. Dynamic ordered sets with exponential search trees. *Journal of the ACM*, 54(3):Article 13, 2007. Announced at STOC’00 and SODA’01.
- [35] David Applegate, Aaron Archer, David S. Johnson, Evdokia Nikolova, Mikkel Thorup, and Ger Yang. Wireless coverage prediction via parametric shortest paths. In *Proceedings of the 19th ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc)*, pages 221–230, 2018.
- [36] David Applegate and Mikkel Thorup. Load optimal MPLS routing with  $n + m$  labels. In *Proceedings of the 22nd Annual Joint Conference of the IEEE Computer and Communications Societies (INFOCOM)*, pages 555–565, 2003.



- [37] Lars Arge and Mikkel Thorup. RAM-efficient external memory sorting. In *Proceedings of the 24th International Symposium on Algorithms and Computation (ISAAC)*, LNCS 8283, pages 491–501, 2013. Best Paper Award. Now covered by [38].
- [38] Lars Arge and Mikkel Thorup. RAM-efficient external memory sorting. *Algorithmica*, 73(4):623–636, 2015. Announced at ISAAC’13 (best paper).
- [39] Matthew H. Austern, Bjarne Stroustrup, Mikkel Thorup, and John Wilkinson. Untangling the balancing and searching of balanced binary search trees. *Software: Practice and Experience*, 33(13):1273–1298, 2003.
- [40] Philip Bille and Mikkel Thorup. Faster regular expression matching. In *Proceedings of the 36th International Colloquium on Automata, Languages and Programming (ICALP)*, LNCS 5555, pages 171–182, 2009.
- [41] Philip Bille and Mikkel Thorup. Regular expression matching with multi-strings and intervals. In *Proceedings of the 21st Annual ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 1279–1308, 2010.
- [42] Andrzej Blikle, Andrzej Tarlecki, and Mikkel Thorup. On conservative extensions of syntax in system development. *Theoretical Computer Science*, 90(1):209–233, 1991. Announced at VDM’90.
- [43] Andrzej Blikle and Mikkel Thorup. On conservative extensions of syntax in the process of system development. In *Proceedings of VDM’90, VDM and Z—Formal Methods in Software Development*, LNCS 428, pages 505–525, 1990. Covered by [42].
- [44] Adam L. Buchsbaum, Howard J. Karloff, Claire Kenyon, Nick Reingold, and Mikkel Thorup. OPT versus LOAD in dynamic storage allocation. In *Proceedings of the 35th Annual ACM Symposium on Theory of Computing (STOC)*, pages 649–658, 2003. Covered by [45].
- [45] Adam L. Buchsbaum, Howard J. Karloff, Claire Kenyon, Nick Reingold, and Mikkel Thorup. OPT versus LOAD in dynamic storage allocation. *SIAM Journal on Computing*, 33(3):632–646, 2004. Announced at STOC’03.
- [46] Luciana S. Buriol, Mauricio G. C. Resende, Celso C. Ribeiro, and Mikkel Thorup. A memetic algorithms for OSPF routing. In *Proceedings of the 6th INFORMS Telecom*, pages 187–188, 2002. Covered by [47].
- [47] Luciana S. Buriol, Mauricio G. C. Resende, Celso C. Ribeiro, and Mikkel Thorup. A hybrid genetic algorithm for the weight setting problem in OSPF/IS-IS routing. *Networks*, 46(1):36–56, 2005. Announced at INFORMS Telecom’02.
- [48] Luciana S. Buriol, Mauricio G. C. Resende, and Mikkel Thorup. Survivable IP network design with OSPF routing. *Networks*, 49(1):51–64, 2007. Announced at Optimization’04.
- [49] Luciana S. Buriol, Mauricio G.C. Resende, and Mikkel Thorup. Speeding up dynamic shortest-path algorithms. *INFORMS Journal computing*, 20(2):191–204, 2008.
- [50] Shiri Chechik, Haim Kaplan, Mikkel Thorup, Or Zamir, and Uri Zwick. Bottleneck Paths and Trees and Deterministic Graphical Games. In *Proceedings of 33rd Symposium on Theoretical Aspects of Computer Science (STACS)*, volume 47 of *Leibniz International Proceedings in Informatics (LIPIcs)*, pages 27:1–27:13, 2016.
- [51] Tobias Christiani, Rasmus Pagh, and Mikkel Thorup. From independence to expansion and back again. In *Proceedings of the 47th ACM Symposium on Theory of Computing (STOC)*, pages 813–820, 2015.

- [52] Tobias Christiani, Rasmus Pagh, and Mikkel Thorup. Confirmation sampling for exact nearest neighbor search. In *Similarity Search and Applications - 13th International Conference, SISAP 2020, Copenhagen, Denmark, September 30 - October 2, 2020, Proceedings*, volume 12440 of *Lecture Notes in Computer Science*, pages 97–110. Springer, 2020.
- [53] Edith Cohen, Nick Duffield, Haim Kaplan, Carsten Lund, and Mikkel Thorup. Algorithms and estimators for accurate summarization of internet traffic. In *Proceedings the ACM Internet Measurement Conference (IMC)*, pages 265–278, 2007.
- [54] Edith Cohen, Nick Duffield, Haim Kaplan, Carsten Lund, and Mikkel Thorup. Sketching unaggregated data streams for subpopulation-size queries. In *Proceedings of the 26th Annual ACM Symposium on Principles of Database Systems (PODS)*, pages 253–262, 2007.
- [55] Edith Cohen, Nick Duffield, Haim Kaplan, Carsten Lund, and Mikkel Thorup. Stream sampling for variance-optimal estimation of subset sums. In *Proceedings of the 20th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 1255–1264, 2009. Covered by [56].
- [56] Edith Cohen, Nick Duffield, Haim Kaplan, Carsten Lund, and Mikkel Thorup. Efficient stream sampling for variance-optimal estimation of subset sums. *SIAM Journal on Computing*, 40(5):1402–1431, 2011. Announced at SODA’09.
- [57] Edith Cohen, Nick Duffield, Haim Kaplan, Carsten Lund, and Mikkel Thorup. Algorithms and estimators for summarization of unaggregated data streams. *Journal of Computer and System Sciences*, 80:1214–1244, 2014.
- [58] Edith Cohen, Nick Duffield, Carsten Lund, and Mikkel Thorup. Confident estimation for multistage measurement sampling and aggregation. In *Proceedings the ACM IFIP Conference on Measurement and Modeling of Computer Systems (SIGMETRICS/Performance)*, pages 109–120, 2008.
- [59] Edith Cohen, Nick G. Duffield, Haim Kaplan, Carsten Lund, and Mikkel Thorup. Composable, scalable, and accurate weight summarization of unaggregated data sets. *Proceedings of Very Large Databases (VLDB) Endowment*, 2(1):431–442, 2009. Journal issue with the papers from 35th VLDB Conference.
- [60] Vincent Cohen-Addad, Debarati Das, Evangelos Kipouridis, Nikos Parotsidis, and Mikkel Thorup. Fitting distances by tree metrics minimizing the total error within a constant factor. In *Proceedings of the 62nd IEEE Symposium on Foundations of Computer Science (FOCS)*, 2022.
- [61] Richard Cole, Martin Farach, Ramesh Hariharan, Teresa Przytycka, and Mikkel Thorup. An  $O(n \log n)$  algorithm for the maximum agreement subtree problem for binary trees. *SIAM Journal on Computing*, 30(5):1385–1404, 2000.
- [62] Søren Dahlgaard, Christian Igel, and Mikkel Thorup. Nearest neighbor classification using bottom-k sketches. In *Proceedings of the 2013 IEEE International Conference on Big Data, 6-9 October 2013, Santa Clara, CA, USA*, pages 28–34, 2013.
- [63] Søren Dahlgaard, Mathias Bæk Tejs Knudsen, Eva Rotenberg, and Mikkel Thorup. The power of two choices with simple tabulation. In *Proceedings of the 27th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 1631–1642, 2016.
- [64] Søren Dahlgaard, Mathias Bæk Tejs Knudsen, and Mikkel Thorup. Fast similarity sketching. In *Proceedings of the 58th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 663–671, 2017.

- [65] Søren Dahlgaard, Mathias Bæk Tejs Knudsen, and Mikkel Thorup. Practical hash functions for similarity estimation and dimensionality reduction. In *Proceedings of the 30th Conference on Neural Information Processing Systems (NIPS)*, pages 6618–6628, 2017.
- [66] Søren Dahlgaard and Mikkel Thorup. Approximately minwise independence with twisted tabulation. In *Proceedings of the 14th Scandinavian Workshop on Algorithm Theory (SWAT), LNCS 8503*, pages 134–145, 2014.
- [67] Søren Dahlgaard, Mathias Bæk Tejs Knudsen, Eva Rotenberg, and Mikkel Thorup. Hashing for statistics over k-partitions. In *Proceedings of the 56th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 1292–1310, 2015.
- [68] Camil Demetrescu, Pompeo Faruolo, Giuseppe F. Italiano, and Mikkel Thorup. Does path cleaning help in dynamic all-pairs shortest paths. In *Proceedings of the 14th European Symposium on Algorithms (ESA), LNCS 4168*, pages 556–579, 2006.
- [69] Camil Demetrescu and Mikkel Thorup. Oracles for distances avoiding a link-failure. In *Proceedings of the 13th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 838–843, 2002.
- [70] Camil Demetrescu, Mikkel Thorup, Rezaul Alam Chowdhury, and Vijaya Ramachandran. Oracles for distances avoiding a failed node or link. *SIAM Journal on Computing*, 37(5):1299–1318, 2008. Announced at SODA’02.
- [71] Yevgeniy Dodis, Mihai Pătraşcu, and Mikkel Thorup. Changing base without losing space. In *Proceedings of the 42nd Annual ACM Symposium on Theory of Computing (STOC)*, pages 593–602, 2010.
- [72] Nick Duffield, Carsten Lund, and Mikkel Thorup. Charging from sampled network usage. In *Proceedings of the 1st ACM SIGCOMM Internet Measurement Workshop (IMW)*, pages 245–256, 2001.
- [73] Nick Duffield, Carsten Lund, and Mikkel Thorup. Properties and prediction of flow statistics from sampled packet streams. In *Proceedings of the 2nd ACM SIGCOMM Internet Measurement Workshop (IMW)*, pages 159–171, 2002. Covered by [76].
- [74] Nick Duffield, Carsten Lund, and Mikkel Thorup. Estimating flow distributions from sampled flow statistics. In *Proceedings the ACM SIGCOMM Conference on Applications, Technologies, Architectures, and Protocols for Computer Communication (SIGCOMM)*, pages 325–336, 2003. Covered by [76].
- [75] Nick Duffield, Carsten Lund, and Mikkel Thorup. Flow sampling under hard resource constraints. In *Proceedings the ACM IFIP Conference on Measurement and Modeling of Computer Systems (SIGMETRICS/Performance)*, pages 85–96, 2004. Covered by [79].
- [76] Nick Duffield, Carsten Lund, and Mikkel Thorup. Estimating flow distributions from sampled flow statistics. *ACM/IEEE Transactions on Networking*, 13(5):933–946, 2005. Announced at SIGCOMM’03 and IMW’02.
- [77] Nick Duffield, Carsten Lund, and Mikkel Thorup. Learn more, sample less: Control of volume and variance in network measurement. *IEEE Transactions on Information Theory*, 51(5):1756–1775, 2005.
- [78] Nick Duffield, Carsten Lund, and Mikkel Thorup. Optimal combination of sampled network measurements. In *Proceedings the ACM Internet Measurement Conference (IMC)*, pages 91–104, 2005.

- [79] Nick Duffield, Carsten Lund, and Mikkel Thorup. Priority sampling for estimation of arbitrary subset sums. *Journal of the ACM*, 54(6):Article 32, 2007. Announced at SIGMETRICS'04.
- [80] Martin Farach, Teresa M. Przytycka, and Mikkel Thorup. Computing the agreement of trees with bounded degrees. In *Proceedings of the 3rd Annual European Symposium on Algorithms (ESA)*, LNCS 979, pages 381–393, 1995. Covered by [81] and [61].
- [81] Martin Farach, Teresa M. Przytycka, and Mikkel Thorup. On the agreement of many trees. *Information Processing Letters*, 55(6):297–301, 1995. Announced at ESA'95.
- [82] Martin Farach and Mikkel Thorup. Fast comparison of evolutionary trees. In *Proceedings of the 5th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 481–488, 1994. Covered by [84].
- [83] Martin Farach and Mikkel Thorup. Optimal evolutionary tree comparison by sparse dynamic programming. In *Proceedings of the 35th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 770–779, 1994. Covered by [86].
- [84] Martin Farach and Mikkel Thorup. Fast comparison of evolutionary trees. *Information and Computation*, 123(1):29–37, 1995. Announced at SODA'94.
- [85] Martin Farach and Mikkel Thorup. String matching in Lempel-Ziv compressed strings. In *Proceedings of the 27th ACM Symposium on the Theory of Computing (STOC)*, pages 703–712, 1995. Covered by [87].
- [86] Martin Farach and Mikkel Thorup. Sparse dynamic programming for evolutionary-tree comparison. *SIAM Journal on Computing*, 26(1):210 – 230, 1997. Announced at FOCS'94.
- [87] Martin Farach and Mikkel Thorup. String matching in Lempel-Ziv compressed strings. *Algorithmica*, 20(4):388–404, 1998. Announced at STOC'95.
- [88] Bernard Fortz, Jennifer Rexford, and Mikkel Thorup. Traffic engineering with traditional IP routing protocols. *IEEE Communications Magazine*, 40(10):118–124, October 2002.
- [89] Bernard Fortz and Mikkel Thorup. Internet traffic engineering by optimizing OSPF weights. In *Proceedings of the 19th IEEE INFOCOM - The Conference on Computer Communications*, pages 519–528, 2000. Covered by [92].
- [90] Bernard Fortz and Mikkel Thorup. Optimizing OSPF/IS-IS weights in a changing world. *IEEE Journal on Selected Areas in Communications (Special Issue on Recent Advances on Fundamentals of Network Management)*, 20(4):756–767, 2002.
- [91] Bernard Fortz and Mikkel Thorup. Robust optimization of OSPF/IS-IS weights. In W. Ben-Ameur and A. Petrowski, editors, *Proceedings of the International Network Optimization Conference (INOC)*, pages 225–230, October 2003.
- [92] Bernard Fortz and Mikkel Thorup. Increasing internet capacity using local search. *Computational Optimization and Applications*, 29(1):13–48, 2004. Announced at INFOCOM'00.
- [93] Mohsen Ghaffari, Krzysztof Nowicki, and Mikkel Thorup. Faster algorithms for edge connectivity via random 2-out contractions. In *Proceedings of the 2020 ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 1260–1279, 2020.
- [94] Gramoz Goranci, Monika Henzinger, and Mikkel Thorup. Incremental exact min-cut in polylogarithmic amortized update time. In *Proceedings of the 24th Annual European Symposium on Algorithms (ESA)*, Leibniz International Proceedings in Informatics (LIPIcs), pages 46:1–46:17, 2016. Covered by [95].

- [95] Gramoz Goranci, Monika Henzinger, and Mikkel Thorup. Incremental exact min-cut in polylogarithmic amortized update time. *ACM Trans. Algorithms*, 14(2):17:1–17:21, 2018. Announced at ESA’16.
- [96] Anupam Gupta, Amit Kumar, and Mikkel Thorup. Tree based MPLS routing. In *Proceedings of the 15th ACM Symposium on Parallel Algorithms (SPAA)*, pages 193–199, 2003.
- [97] Yijie Han and Mikkel Thorup. Integer sorting in  $O(n\sqrt{\log \log n})$  expected time and linear space. In *Proceedings of the 43rd IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 135–144, 2002.
- [98] Monika Rauch Henzinger and Mikkel Thorup. Improved sampling with applications to dynamic graph algorithms. In *Proceedings of the 23rd International Colloquium on Automata Languages, and Programming (ICALP), LNCS 1099*, pages 290–299, 1996. Covered by [99].
- [99] Monika Rauch Henzinger and Mikkel Thorup. Sampling to provide or to bound: With applications to fully dynamic graph algorithms. *Random Structures and Algorithms*, 11:369–379, 1997. Announced at ICALP’96.
- [100] Jabob Holm, Valerie King, Mikkel Thorup, Or Zamir, and Uri Zwick. Random  $k$ -out subgraph leaves only  $O(n/k)$  inter-component edges. In *Proceedings of the 60th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 896–909, 2019.
- [101] Jacob Holm, Kristian de Lichtenberg, and Mikkel Thorup. Poly-logarithmic deterministic fully-dynamic algorithms for connectivity, minimum spanning tree, 2-edge and biconnectivity. In *Proceedings of the 30th ACM Symposium on the Theory of Computing (STOC)*, pages 79–89, 1998. Covered by [102].
- [102] Jacob Holm, Kristian de Lichtenberg, and Mikkel Thorup. Poly-logarithmic deterministic fully-dynamic algorithms for connectivity, minimum spanning tree, 2-edge and biconnectivity. *Journal of the ACM*, 48(4):723–760, 2001. Announced at STOC’98.
- [103] Jacob Holm, Eva Rotenberg, and Mikkel Thorup. Planar reachability in linear space and constant time. In *Proceedings of the 56th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 370–389, 2015.
- [104] Jacob Holm, Eva Rotenberg, and Mikkel Thorup. Dynamic bridge-finding in  $\tilde{O}(\log^2)$  amortized time. In *Proceedings of the 29th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 35–52, 2018.
- [105] Ken ichi Kawarabayashi, Christian Sommer, and Mikkel Thorup. More compact oracles for approximate distances in undirected planar graphs. In *Proceedings of the 24th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 550–563, 2013.
- [106] Ken ichi Kawarabayashi and Mikkel Thorup. The minimum  $k$ -way cut of bounded size is fixed-parameter tractable. In *Proceedings of the 52nd IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 160–169, 2011.
- [107] Ken ichi Kawarabayashi and Mikkel Thorup. Combinatorial coloring of 3-colorable graphs. In *Proceedings of the 53rd IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 68–75, 2012. Covered by [110].
- [108] Ken ichi Kawarabayashi and Mikkel Thorup. Coloring 3-colorable graphs with  $o(n^{1/5})$  colors. In *Proceedings of The 31st International Symposium on Theoretical Aspects of Computer Science (STACS), LIPIcs 25*, pages 458–469, 2014. Covered by [110].

- [109] Ken ichi Kawarabayashi and Mikkel Thorup. Deterministic global minimum cut of a simple graph in near-linear time. In *Proceedings of the 47th ACM Symposium on Theory of Computing (STOC)*, pages 665–674, 2015. Covered by [111]. Co-winner of 2021 Fulkerson Prize.
- [110] Ken ichi Kawarabayashi and Mikkel Thorup. Coloring 3-colorable graphs with less than  $n^{1/5}$  colors. *Journal of the ACM*, 64(1):Article 4, 2017. Combines results announced at FOCS’12 and STACS’14.
- [111] Ken ichi Kawarabayashi and Mikkel Thorup. Deterministic edge connectivity in near-linear time. *Journal of the ACM*, 66(1):Article 4, 2019. Announced at STOC’15 under the title Deterministic Global Minimum Cut of a Simple Graph in Near-Linear Time.
- [112] Raj D. Iyer, David Karger, Hariharan S. Rahul, and Mikkel Thorup. An experimental study of poly-logarithmic fully-dynamic connectivity algorithms. In *Proceedings of the 2nd Workshop on Algorithms Engineering and Experiments (ALENEX)*, pages 59–78, 2000. Covered by [113].
- [113] Raj D. Iyer, David Karger, Hariharan S. Rahul, and Mikkel Thorup. An experimental study of poly-logarithmic fully-dynamic connectivity algorithms. *ACM Journal of Experimental Algorithmics*, 6: Article 4, 2001. Announced at ALENEX’00.
- [114] David Karger, Philip Klein, Cliff Stein, , Mikkel Thorup, and Neal Young. Rounding algorithms for a geometric embedding of minimum multiway cut. *Mathematics of Operations Research*, 29(3):436–461, 2004. Announced at STOC’99.
- [115] David Karger, Philip Klein, Cliff Stein, Mikkel Thorup, and Neal Young. Rounding algorithms for a geometric embedding of minimum multiway cut. In *Proceedings of the 31st ACM Symposium on the Theory of Computing (STOC)*, pages 668–678, 1999. Covered by [114].
- [116] Casper Kejlberg-Rasmussen, Tsvi Kopelowitz, Seth Pettie, and Mikkel Thorup. Faster worst case deterministic dynamic connectivity. In *Proceedings of the 24th Annual European Symposium on Algorithms, ESA 2016, August 22-24, 2016, Aarhus, Denmark*, Leibniz International Proceedings in Informatics (LIPIcs), pages 53:1–53:15, 2016.
- [117] Valerie King, Shay Kutten, and Mikkel Thorup. Construction and impromptu repair of an MST in a distributed network with  $o(m)$  communication. In *Proceedings of the 2015 ACM Symposium on Principles of Distributed Computing (PODC)*, pages 71–80, 2015.
- [118] Valerie King and Mikkel Thorup. A space saving trick for directed dynamic transitive closure and shortest path algorithms. In *Proceedings of the 7th Annual International Computing and Combinatorics Conference (COCOON), LNCS 2108*, pages 268–277, 2001.
- [119] Mathias Bæk Tejs Knudsen and Mikkel Thorup. The entropy of backwards analysis. In *Proceedings of the 29th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 867–880, 2018.
- [120] Kai-Yuan Lai, Hsueh-I Lu, and Mikkel Thorup. Three-in-a-tree in near linear time. In *Proceedings of the 52nd Annual ACM SIGACT Symposium on Theory of Computing (STOC)*, pages 1279–1292, 2020.
- [121] Kasper Green Larsen, Jelani Nelson, Huy L. Nguyen, and Mikkel Thorup. Heavy hitters via cluster-preserving clustering. In *Proceedings of the 57th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 61–70, 2016.

- [122] Kasper Green Larsen, Jelani Nelson, Huy L. Nguyen, and Mikkel Thorup. Heavy hitters via cluster-preserving clustering (invited research highlight). *Communications of the ACM*, 62(8):95–100, 2019.
- [123] On-Hei Solomon Lo, Jens M. Schmidt, and Mikkel Thorup. Compact cactus representations of all non-trivial min-cuts. *Discret. Appl. Math.*, 303:296–304, 2021.
- [124] Omid Madani, Mikkel Thorup, and Uri Zwick. Discounted deterministic Markov decision processes and discounted all-pairs shortest paths. In *Proceedings of the 20th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 958–967, 2009. Covered by [125].
- [125] Omid Madani, Mikkel Thorup, and Uri Zwick. Discounted deterministic markov decision processes and discounted all-pairs shortest paths. *ACM Transactions on Algorithms*, 6(2), 2010. Announced at SODA’09.
- [126] Ran Mendelson, Robert Tarjan, Mikkel Thorup, and Uri Zwick. Melding priority queues. In *Proceedings of the 9th Scandinavian Workshop on Algorithm Theory (SWAT)*, pages 223–235, 2004. Covered by [127].
- [127] Ran Mendelson, Robert Tarjan, Mikkel Thorup, and Uri Zwick. Melding priority queues. *ACM Transactions on Algorithms*, 2(4):535–557, 2006. Announced at SODA’03 and SWAT’04.
- [128] Ran Mendelson, Mikkel Thorup, and Uri Zwick. Meldable RAM priority queues and minimum directed spanning trees. In *Proceedings of the 15th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 40–48, 2003. Covered by [127].
- [129] Vahab S. Mirrokni, Mikkel Thorup, and Morteza Zadimoghaddam. Consistent hashing with bounded loads. In *Proceedings of the 29th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 587–604, 2018.
- [130] Anna Pagh, Rasmus Pagh, and Mikkel Thorup. On adaptive integer sorting. In *Proceedings of the 12th European Symposium on Algorithms (ESA)*, LNCS 3221, pages 556–579, 2004.
- [131] Rasmus Pagh, Nina Mesing Stausholm, and Mikkel Thorup. Hardness of bichromatic closest pair with jaccard similarity. In *27th Annual European Symposium on Algorithms, ESA 2019, September 9-11, 2019, Munich/Garching, Germany.*, pages 74:1–74:13, 2019.
- [132] Mike Paterson, Yuval Peres, Mikkel Thorup, Peter Winkler, and Uri Zwick. Maximum overhang. In *Proceedings of the 19th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 756–765, 2008. Covered by [133].
- [133] Mike Paterson, Yuval Peres, Mikkel Thorup, Peter Winkler, and Uri Zwick. Maximum overhang. *The American Mathematical Monthly*, 116(9):763–787, 2009. Announced at SODA’08, and featured in *Science*, page 323: 875, Feb. 13, 2009. Co-winner of 2011 MAA Robbins Award.
- [134] Mihai Pătraşcu, Liam Roditty, and Mikkel Thorup. A new infinity of distance oracles for sparse graphs. In *Proceedings of the 53rd IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 738–747, 2012.
- [135] Mihai Pătraşcu and Mikkel Thorup. Higher lower bounds for near-neighbor and further rich problems. In *Proceedings of the 47th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 646–654, 2006. Covered by [139].

- [136] Mihai Pătraşcu and Mikkel Thorup. Time-space trade-offs for predecessor search. In *Proceedings of the 38th Annual ACM Symposium on Theory of Computing (STOC)*, pages 232–240, 2006.
- [137] Mihai Pătraşcu and Mikkel Thorup. Planning for fast connectivity updates. In *Proceedings of the 48th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 646–654, 2007.
- [138] Mihai Pătraşcu and Mikkel Thorup. Randomization does not help searching predecessors. In *Proceedings of the 18th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 555–564, 2007.
- [139] Mihai Pătraşcu and Mikkel Thorup. Higher lower bounds for near-neighbor and further rich problems. *SIAM Journal on Computing*, 39(2):730–741, 2009. Special issue from FOCS’06.
- [140] Mihai Pătraşcu and Mikkel Thorup. On the  $k$ -independence required by linear probing and minwise independence. In *Proceedings of the 36th International Colloquium on Automata, Languages and Programming (ICALP), Part I, LNCS 6198*, pages 715–726, 2010. Covered by [146].
- [141] Mihai Pătraşcu and Mikkel Thorup. Don’t rush into a union: take time to find your roots. In *Proceedings of the 43rd Annual ACM Symposium on Theory of Computing (STOC)*, pages 559–568, 2011.
- [142] Mihai Pătraşcu and Mikkel Thorup. The power of simple tabulation hashing. In *Proceedings of the 43rd Annual ACM Symposium on Theory of Computing (STOC)*, pages 1–10, 2011. Covered by [143].
- [143] Mihai Pătraşcu and Mikkel Thorup. The power of simple tabulation hashing. *Journal of the ACM*, 59(3):Article 14, 2012. Announced at STOC’11.
- [144] Mihai Pătraşcu and Mikkel Thorup. Twisted tabulation hashing. In *Proceedings of the 24th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 209–228, 2013.
- [145] Mihai Pătraşcu and Mikkel Thorup. Dynamic integer sets with optimal rank, select, and predecessor search. In *Proceedings of the 55nd IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 166–175, 2014.
- [146] Mihai Pătraşcu and Mikkel Thorup. On the  $k$ -independence required by linear probing and minwise independence. *ACM Transactions on Algorithms*, 12(1):Article 8, 2016. Announced at ICALP’10.
- [147] Liam Roditty, Mikkel Thorup, and Uri Zwick. Roundtrip spanners and roundtrip routing in directed graphs. In *Proceedings of the 13th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 844–851, 2002.
- [148] Liam Roditty, Mikkel Thorup, and Uri Zwick. Deterministic constructions of approximate distance oracles and spanners. In *Proceedings of the 32th International Colloquium on Automata Languages, and Programming (ICALP), LNCS 3580*, pages 261–272, 2005.
- [149] Liam Roditty, Mikkel Thorup, and Uri Zwick. Roundtrip spanners and roundtrip routing in directed graphs. *ACM Transactions on Algorithms*, 4(3):Article 29, 2008. Announced at SODA’02.
- [150] Matthew Roughan, Mikkel Thorup, and Yin Zhang. Performance of estimated traffic matrices in traffic engineering. In *Proceedings of the International Conference on Measurements and Modeling of Computer Systems (SIGMETRICS)*, pages 326–327, 2003.



- [151] Matthew Roughan, Mikkel Thorup, and Yin Zhang. Traffic engineering with estimated traffic matrices. In *Proceedings the ACM Internet Measurement Conference (IMC)*, pages 248–258, 2003.
- [152] Mario Szegedy and Mikkel Thorup. On the variance of subset sum estimation. In *Proceedings of the 15th European Symposium on Algorithms (ESA), LNCS 4698*, pages 75–86, 2007.
- [153] Mikkel Thorup. Zenons paradoks – ren logik eller snedig rethorik. *Kvant, Fysisk Tidsskrift*, 1:24–26, 1990.
- [154] Mikkel Thorup. On shortcutting digraphs. In *Proceedings of the 18th International Workshop on Graph-Theoretic Concepts in Computer Science (WG), LNCS 657*, pages 205–211, 1993.
- [155] Mikkel Thorup. Controlled grammatic ambiguity. *ACM Transactions on Programming Languages and Systems*, 16(3):1024–1050, 1994.
- [156] Mikkel Thorup. Efficient preprocessing of simple binary pattern forests. In *Proceedings of the 4th Scandinavian Workshop on Algorithm Theory (SWAT), LNCS 824*, pages 350–358, 1994. Covered by [159].
- [157] Mikkel Thorup. Shortcutting planar digraphs. *Combinatorics, Probability & Computing*, 4:287–315, 1995.
- [158] Mikkel Thorup. Disambiguating grammars by exclusion of sub-parse trees. *Acta Informatica*, 33(6):511–522, 1996.
- [159] Mikkel Thorup. Efficient preprocessing of simple binary pattern forests. *Journal of Algorithms*, 20:602–612, 1996. Announced at SWAT’94.
- [160] Mikkel Thorup. On RAM priority queues. In *Proceedings of the 7th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 59–67, 1996. Covered by [175].
- [161] Mikkel Thorup. Decremental dynamic connectivity. In *Proceedings of the 8th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 305–313, 1997. Covered by [170].
- [162] Mikkel Thorup. Parallel shortcutting of rooted trees. *Journal of Algorithms*, 23(1):139–159, 1997.
- [163] Mikkel Thorup. Randomized sorting in  $O(n \log \log n)$  time and linear space using addition, shift, and bit-wise boolean operations. In *Proceedings of the 8th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 352–359, 1997. Covered by [181].
- [164] Mikkel Thorup. Structured programs have small tree-width and good register allocation. In *Proceedings of the 23rd International Workshop on Graph-Theoretic Concepts in Computer Science (WG), LNCS 1335*, pages 318–332, 1997. Covered by [166].
- [165] Mikkel Thorup. Undirected single source shortest paths in linear time. In *Proceedings of the 38th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 12–21, 1997. Covered by [171].
- [166] Mikkel Thorup. All structured programs have small tree width and good register allocation. *Information and Computation*, 142(2):159–181, 1998. Announced at WG’97.
- [167] Mikkel Thorup. Faster deterministic sorting and priority queues in linear space. In *Proceedings of the 9th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 550–555, 1998.

- [168] Mikkel Thorup. Floats, integers, and single source shortest paths. In *Proceedings of the 15th Symposium on Theoretical Aspects of Computer Science (STACS), LNCS 1373*, pages 14–24, 1998. Covered by [173].
- [169] Mikkel Thorup. Map graphs in polynomial time. In *Proceedings of the 39th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 396–405, 1998.
- [170] Mikkel Thorup. Decremental dynamic connectivity. *Journal of Algorithms*, 33:229–243, 1999. Announced at SODA’97.
- [171] Mikkel Thorup. Undirected single source shortest paths with positive integer weights in linear time. *Journal of the ACM*, 46(3):362–394, 1999. Announced at FOCS’97.
- [172] Mikkel Thorup. Even strongly universal hashing is pretty fast. In *Proceedings of the 11th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 496–497, 2000.
- [173] Mikkel Thorup. Floats, integers, and single source shortest paths. *Journal of Algorithms*, 35:189–201, 2000. Announced at STACS’98.
- [174] Mikkel Thorup. Near-optimal fully-dynamic graph connectivity. In *Proceedings of the 32nd ACM Symposium on the Theory of Computing (STOC)*, pages 343–350, 2000.
- [175] Mikkel Thorup. On RAM priority queues. *SIAM Journal on Computing*, 30(1):86–109, 2000. Announced at SODA’96.
- [176] Mikkel Thorup. Compact oracles for reachability and approximate distances in planar digraphs. In *Proceedings of the 42nd IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 242–251, 2001. Covered by [187].
- [177] Mikkel Thorup. Fully-dynamic min-cut. In *Proceedings of the 33rd ACM Symposium on the Theory of Computing (STOC)*, pages 224–230, 2001.
- [178] Mikkel Thorup. Quick  $k$ -median,  $k$ -center, and facility location for sparse graphs. In *Proceedings of the 28th International Colloquium on Automata Languages, and Programming (ICALP), LNCS 2076*, pages 249–260, 2001. Covered by [190].
- [179] Mikkel Thorup. Equivalence between priority queues and sorting. In *Proceedings of the 43rd IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 125–134, 2002. Covered by [194].
- [180] Mikkel Thorup. On distance oracles and routing in graphs (invited talk). In *Proceedings of the 10th Annual European Symposium on Algorithms (ESA), LNCS 2461*, page 4, 2002.
- [181] Mikkel Thorup. Randomized sorting in  $O(n \log \log n)$  time and linear space using addition, shift, and bit-wise boolean operations. *Journal of Algorithms*, 42(2):205–230, 2002. Announced at SODA’97.
- [182] Mikkel Thorup. Combinatorial power in multimedia processors. *ACM SIGARCH Computer Architecture News*, 31(5):5–11, 2003.
- [183] Mikkel Thorup. Integer priority queues with decrease key in constant time and the single source shortest paths problem. In *Proceedings of the 35th Annual ACM Symposium on Theory of Computing (STOC)*, pages 149–158, 2003. Covered by [189].
- [184] Mikkel Thorup. On  $AC^0$  implementations of fusion trees and atomic heaps. In *Proceedings of the 14th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 699–707, 2003.

- [185] Mikkel Thorup. Quick and good facility location. In *Proceedings of the 14th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 178–185, 2003.
- [186] Mikkel Thorup. Space efficient dynamic stabbing with fast queries. In *Proceedings of the 35th Annual ACM Symposium on Theory of Computing (STOC)*, pages 649–658, 2003.
- [187] Mikkel Thorup. Compact oracles for reachability and approximate distances in planar digraphs. *Journal of the ACM*, 51(6):993–1024, 2004. Announced at FOCS’01.
- [188] Mikkel Thorup. Fully-dynamic all-pairs shortest paths: Faster and allowing negative cycles. In *Proceedings of the 9th Scandinavian Workshop on Algorithm Theory (SWAT)*, pages 384–396, 2004.
- [189] Mikkel Thorup. Integer priority queues with decrease key in constant time and the single source shortest paths problem. *Journal of Computer and System Sciences*, 69(3):330–353, 2004. Special issue from STOC’03.
- [190] Mikkel Thorup. Quick  $k$ -median,  $k$ -center, and facility location for sparse graphs. *SIAM Journal on Computing*, 34(2):405–432, 2005. Announced at ICALP’01.
- [191] Mikkel Thorup. Worst-case update times for fully-dynamic all-pairs shortest paths. In *Proceedings of the 37th Annual ACM Symposium on Theory of Computing (STOC)*, pages 112–119, 2005.
- [192] Mikkel Thorup. Confidence intervals for priority sampling. In *Proceedings the ACM IFIP Conference on Measurement and Modeling of Computer Systems (SIGMETRICS/Performance)*, pages 252–263, 2006.
- [193] Mikkel Thorup. Compact oracles for approximate distances around obstacles in the plane. In *Proceedings of the 15th European Symposium on Algorithms (ESA), LNCS 4698*, pages 383–394, 2007.
- [194] Mikkel Thorup. Equivalence between priority queues and sorting. *Journal of the ACM*, 54(6):Article 28, 2007. Announced at FOCS’02.
- [195] Mikkel Thorup. Fully-dynamic min-cut. *Combinatorica*, 27(1):91–127, 2007. Announced at STOC’01.
- [196] Mikkel Thorup. Minimum  $k$ -way cuts via deterministic greedy tree packing. In *Proceedings of the 40th Annual ACM Symposium on Theory of Computing (STOC)*, pages 159–166, 2008.
- [197] Mikkel Thorup. String hashing for linear probing. In *Proceedings of the 20th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 655–664, 2009.
- [198] Mikkel Thorup. Timeouts with time-reversed linear probing. In *Proceedings of the 30th Annual Joint Conference of the IEEE Computer and Communications Societies (INFOCOM)*, pages 166–170, 2011.
- [199] Mikkel Thorup. Bottom- $k$  and priority sampling, set similarity and subset sums with minimal independence. In *Proceedings of the 45th Annual ACM Symposium on Theory of Computing (STOC)*, pages 371–380, 2013.
- [200] Mikkel Thorup. Funding successful research (viewpoint). *Communications of the ACM*, 56(3):38–39, 2013.
- [201] Mikkel Thorup. Mihai Pătrașcu: obituary and open problems. *ACM SIGACT News*, 44(1):110–114, 2013. Based on invited talk “The work of Mihai Pătrașcu” at the 53rd IEEE Symposium on Foundations of Computer Science (FOCS), 2012.

- [202] Mikkel Thorup. Simple tabulation, fast expanders, double tabulation, and high independence. In *Proceedings of the 54th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 90–99, 2013.
- [203] Mikkel Thorup.  $\text{Sample}(x) = (a \cdot x \leq t)$  is a distinguisher with probability  $1/8$ . In *Proceedings of the 56th IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 1277–1291, 2015. Covered by [207].
- [204] Mikkel Thorup. Fast and powerful hashing using tabulation (invited research highlight). *Communications of the ACM*, 60(7):94–101, 2017.
- [205] Mikkel Thorup. Fast and powerful hashing using tabulation (invited talk). In *Proceedings of the 44th International Colloquium on Automata, Languages, and Programming, ICALP 2017, July 10-14, 2017, Warsaw, Poland*, pages 4:1–4:2, 2017. Similar invited/key note talk presented at FSTTCS’16 and FOGA’17. Covered by [204].
- [206] Mikkel Thorup, editor. *Proceedings of the 59th IEEE Annual Symposium on Foundations of Computer Science, FOCS 2018, Paris, France, October 7-9, 2018*. IEEE Computer Society, 2018.
- [207] Mikkel Thorup.  $\text{Sample}(x) = (a \cdot x \leq t)$  is a distinguisher with probability  $1/8$ . *SIAM Journal on Computing*, 47(6):2510—2526, 2018. Special issue from FOCS’15.
- [208] Mikkel Thorup and David Karger. Dynamic graph algorithms with applications (invited talk). In *Proceedings of the 7th Scandinavian Workshop on Algorithms Theory (SWAT), LNCS 1851*, pages 1–9, 2000.
- [209] Mikkel Thorup, Or Zamir, and Uri Zwick. Dynamic ordered sets with approximate queries, approximate heaps and soft heaps. In *Proceedings of the 46th International Colloquium on Automata, Languages, and Programming, ICALP 2019, July 9-12, 2019, Patras, Greece.*, pages 95:1–95:13, 2019.
- [210] Mikkel Thorup and Yin Zhang. Tabulation based 4-universal hashing with applications to second moment estimation. In *Proceedings of the 15th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 608–617, 2004. Covered by [212].
- [211] Mikkel Thorup and Yin Zhang. Tabulation based 5-universal hashing and linear probing. In *Proceedings of the 12th Workshop on Algorithm Engineering and Experiments (ALENEX)*, pages 62–76, 2010. Covered by [212].
- [212] Mikkel Thorup and Yin Zhang. Tabulation-based 5-independent hashing with applications to linear probing and second moment estimation. *SIAM Journal on Computing*, 41(2):293–331, 2012. Announced at SODA’04 and ALENEX’10.
- [213] Mikkel Thorup and Uri Zwick. Approximate distance oracles. In *Proceedings of the 33rd ACM Symposium on the Theory of Computing (STOC)*, pages 183–192, 2001. Covered by [215]. Received 20-year STOC Test of Time award in 2021.
- [214] Mikkel Thorup and Uri Zwick. Compact routing schemes. In *Proceedings of the 13th ACM Symposium on the Parallel Algorithms and Architectures (SPAA)*, pages 1–10, 2001.
- [215] Mikkel Thorup and Uri Zwick. Approximate distance oracles. *Journal of the ACM*, 52(1):1–24, 2005. Announced at STOC’01.
- [216] Mikkel Thorup and Uri Zwick. Spanners and emulators with sublinear distance errors. In *Proceedings of the 17th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 802–809, 2006.

## Patents

1. Methods and systems for fast optimization of network traffic. Mikkel Thorup and Bernard Fortz. US 6,829,220, Dec. 7, 2004.
2. Method and apparatus for size-dependent sampling for managing a data network. Nick Duffield, Carsten Lund, and Mikkel Thorup. US 7,080,136, Jul. 18, 20, 2006.
3. Methods and systems for optimizing network traffic. Mikkel Thorup and Bernard Fortz. US 7,185,104, Feb. 27, 2007.
4. Apparatus for size-dependent sampling for managing a data network. Nick Duffield, Carsten Lund, and Mikkel Thorup. US 7,299,283, Nov. 20, 2007
5. Optimal combination of sampled measurements. Nick Duffield, Carsten Lund, and Mikkel Thorup. US 7,536,455, May 19, 2009
6. Method and Apparatus for Updating a Shortest Path Graph. Luciana Buriol, Mauricio Guilherme de Carvalho Resende, Mikkel Thorup, US 7,593,341, Sep 22, 2009
7. Method and apparatus for providing composite link assignment in network design. Diogo Andrade, Luciana Buriol, Mauricio Guilherme de Carvalho Resende, Mikkel Thorup. US 7,599,385, Oct 6, 2009.
8. Algorithms and Estimators for Accurate Summarization of Unaggregated Data Streams. Edith Cohen, Nick Duffield, Haim Kaplan, Carsten Lund, and Mikkel Thorup. US 7,746,808, June 29, 2010.
9. Algorithms and estimators for summarization of unaggregated data streams. Edith Cohen, Nick Duffield, Haim Kaplan, Carsten Lund, and Mikkel Thorup. US 7,764,625, July 27, 2010.
10. Sampling and analyzing packets in a network. Carsten Lund, Edith Cohen, Nick Duffield, Alexandre Gerber, Adam Hersh, Oliver Spatscheck, Mikkel Thorup, and Fred True. US 7,852,785, Dec. 14, 2010.
11. Timeouts with time-reversed linear probing. Mikkel Thorup. US 7,861,004, Dec. 28, 2010.
12. Methods And Apparatus To Bound Network Traffic Estimation Error For Multistage Measurement Sampling And Aggregation. Edith Cohen, Nick Duffield, Carsten Lund, Mikkel Thorup. US 7,990,982 B2, August 2, 2011.
13. Variance-optimal sampling-based estimation of subset sums. Edith Cohen, Nick Duffield, Carsten Lund, Haim Kaplan, Mikkel Thorup. US 8,005,949, August 23, 2011.
14. Optimal combination of sampled measurements. Nick Duffield, Carsten Lund, Mikkel Thorup. US 8,028,055, September 27, 2011.
15. Method for summarizing data in unaggregated data streams. Edith Cohen, Nick Duffield, Haim Kaplan, Carsten Lund, Mikkel Thorup. US 8,195,710, June 5, 2012.
16. Time-outs with time-reversed linear probing. Mikkel Thorup. US 8,306,958, November 6, 2012.
17. System and method for regular expression matching with multi-strings and intervals. Mikkel Thorup, Philip Bille. US 8,843,508 B2, September 23, 2014.
18. Methods, systems, and product for hashing using twisted tabulation. Mikkel Thorup, Mihai Pătraşcu. US 8,954,749, February 10, 2015.