Curriculum Vitae for Mikkel Thorup (generated February 1, 2018)

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 visitor at *Massachusetts Institute of Technology (MIT).*

1998–2013 *AT&T Labs Research.* Lead Member of Technical Staff.

Since 2013 *University of Copenhagen.* Full Professor.

2013-2018 Head of Center for *Efficient Algorithms and Data Structures (EADS)* supported by an Advanced Grant of €1.3 million from the Danish Council for Independent Research under the Sapere Aude research carrier programme.

2017–2023 VILLUM Investigator and Head of Center for *Basic Algorithms Research Copenhagen (BARC)* supported by a €5.3 million grant from the VILLUM Foundation.

Honorary

1997 *Distinguished Visiting Professor at Max-Plank-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. About 30 fellows are named each year 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 *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 [116]. *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.

Other appointments

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

2009–2015 *Octoshape.* Member of Advisory Board until it got sold to Akamai.

Research

My main area of research is algorithms and data structures. While working at AT&T, I have also worked a lot with applications within the Internet. Besides publishing papers on the Internet, I got many patents granted, and I had several algorithms running on the AT&T backbone.

Publication venues

To help the reader from a different field appreciate the record, let me point to the top journals and conferences from an algorithms perspective. The *Association for Computing Machinery (ACM)* is the main academic society of computer science and 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 at 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*.

In computer science, publication in very selective refereed conference proceedings is crucial for impact. 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)*. Below these, on the second highest level, we have the more European *International Colloquium on Automata Languages, and Programming (ICALP)* as well as the more specialized *ACM-SIAM Symposium on Discrete Algorithms (SODA)*. The above is only the hit list for algorithms which is my main area. I publish in several other areas, e.g., in applied Internet research where *ACM/IEEE Transactions on Networking* is the top specialized journal while the two top conferences are *SIGCOMM* and *INFOCOM*.

Editorial Boards

- Associate Editor of *Journal of Discrete Algorithms* 1998-2004.
- Associate Editor of *Journal of Algorithms*[1] 1999–2004.
- Associate Editor of *ACM Transactions on Algorithms* since 2004–2015.
- Associate Editor of *SIAM Journal on Computing* since 2004.
- Area Editor of Algorithms and Data Structures for *Journal of ACM* since 2004.
- Associate Editor of *Theory of Computing* — an open access journal, since 2005.

Program Committees

- The 29th Annual ACM Symposium on Theory of Computing (STOC), El Paso, Texas, May 4–6, 1997.
- 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.
- PC chair for the 59th Annual IEEE Symposium on Foundations of Computer Science (FOCS) Paris, France, October 7-9, 2018.

[1] Participated in the *J. Algorithms* editorial board resignation against high commercial prizing, creating *ACM Trans. Algorithms* instead.

Students

While at University of Copenhagen in 1993-1998 I supervised the thesis work of 9 Master's students and 1 PhD student. The average mark for the Master's thesis I supervised was 10.9 which is excellent in the Danish system. My thesis supervision was mostly research oriented and resulted in several publications with students [9, 10, 11, 12, 16, 17, 18, 19, 20, 89, 90]. 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. I was myself on the Technical Advisory Board for Octoshape. He is now a full professor in my group at DIKU.

While at AT&T I have been 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.

Since I returned to DIKU in 2013 I have (co-)supervised 4 PhD-students that all finished in 2017, all with outstandig publication records: Søren Dahlgaard and Mathias Bæk Tejs Knudsen who co-founded a start-up Supwiz, Eva Rotenberg who is now Associate Professor at the Technical University of Denmark, and Mikkel Abrahamsen who joined 3shape. My current PhD students are Jacob Holm and Anders Aamand.

Publications

H-factor 55 according to Google Scholar on October 7, 2017, with 13,297 citations. In my field, we normally follow the tradition of alphabetic ordering of authors to indicate equal authorship. This tradition is only broken in extreme cases.

[1] 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.

[2] 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.

[3] 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.

[4] 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 [5].

[5] 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.

[6] 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.

[7] 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 [8].

[8] 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.

[9] Stephen Alstrup, Dov Harel, Peter W. Lauridsen, and Mikkel Thorup. Dominators in linear time. *SIAM Journal on Computing*, 28(6):2117–2132, 1999.

[10] 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.

[11] 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.

[12] 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.

[13] 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.

[14] 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.

[15] 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.

[16] 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.

[17] 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 [18].

[18] Stephen Alstrup, Peter W. Lauridsen, and Mikkel Thorup. Generalized dominators for structured programs. *Algorithmica*, 27(3):244–253, 2000. Announced at STACS'96.

[19] 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.

[20] 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 [21].

[21] 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.

[22] Aysegül Altin, Bernard Fortz, Mikkel Thorup, and Hakan Ümit. Intra-domain traffic engineering with shortest path routing protocols. *4OR*, 7(4):301–335, 2009.

[23] 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 updated version of [22].

[24] 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.

[25] 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.

[26] 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 [28].

[27] 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 [28].

[28] 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.

[29] 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.

[30] 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 [31].

[31] Lars Arge and Mikkel Thorup. RAM-efficient external memory sorting. *Algorithmica*, 73(4):623–636, 2015. Announced at ISAAC'13 (best paper).

[32] 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.

[33] 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.

[34] 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.

[35] 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.

[36] 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 [35].

[37] 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 [38].

[38] 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.

[39] 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 [40].

[40] 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.

[41] 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.

[42] Luciana S. Buriol, Mauricio G.C. Resende, and Mikkel Thorup. Speeding up dynamic shortest-path algorithms. *INFORMS Journal computing*, 20(2):191–204, 2008.

[43] 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.

[44] 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.

[45] 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.

[46] 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.

[47] 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 [48].

[48] 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.

[49] 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.

[50] 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.

[51] 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.

[52] 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.

[53] 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.

[54] 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.

[55] 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.

[56] Søren Dahlgaard, Mathias Bæk Tejs Knudsen, and Mikkel Thorup. Practical hash functions for similarity estimation and dimensionality reduction. In *Advances in Neural Information Processing Systems 30: Annual Conference on Neural Information Processing Systems 2017, 4-9 December 2017, Long Beach, CA, USA*, pages 6618–6628, 2017.

[57] 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.

[58] Sren 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.

[59] 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.

[60] 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.

[61] 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.

[62] 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.

[63] 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.

[64] 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 [67].

[65] 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 [67].

[66] 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 [70].

[67] 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.

[68] 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.

[69] 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.

[70] 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.

[71] 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 [72] and [52].

[72] 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.

[73] 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 [75].

[74] 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 [77].

[75] Martin Farach and Mikkel Thorup. Fast comparison of evolutionary trees. *Information and Computation*, 123(1):29–37, 1995. Announced at SODA'94.

[76] 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 [78].

[77] 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.

[78] Martin Farach and Mikkel Thorup. String matching in Lempel-Ziv compressed strings. *Algorithmica*, 20(4):388–404, 1998. Announced at STOC'95.

[79] Bernard Fortz, Jennifer Rexford, and Mikkel Thorup. Traffic engineering with traditional IP routing protocols. *IEEE Communications Magazine*, 40(10):118–124, October 2002.

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[81] 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.

[82] 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.

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[84] Gramoz Goranci, Monika Henzinger, and Mikkel Thorup. Incremental exact min-cut in poly-logarithmic 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.

[85] 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.

[86] Yijie Han and Mikkel Thorup. Integer sorting in $O(n\sqrt{\log\log n})$ expected time and linear space. In *Proceedings of the 43nd IEEE Symposium on Foundations of Computer Science (FOCS)*, pages 135–144, 2002.

[87] 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 [88].

[88] 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.

[89] 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 [90].

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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.