Martin Aumüller

Curriculum Vitae: June, 2022

Email:	maau@itu.dk
Address:	IT University of Copenhagen Algorithms Group Rued Langgaards Vej 7 Office 4B05 DK-2300 København S Denmark
Birth:	January 12, 1986 in Gera, Germany
Citizenship:	Germany
Website:	http://www.itu.dk/people/maau

Areas of interest

Broad interests:	algorithms and data structures, algorithm engineering, algorithmic fairness & privacy
Specific interests:	• design of randomized algorithms for massive data sets • analysis of algorithms • algorithm engineering for sorting & similarity search algorithms • algorithmic privacy using differential privacy

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Academic positions

Jun. 2022–	Affiliated with Providentia at University of Copenhagen https://www.rasmuspagh.net/providentia/
Jul. 2021–current	Associate Professor in Computer Science at IT University of Copenhagen
Aug. 2018–Jun. 2020	Assistant Professor in Computer Science at IT University of Copenhagen (8 months 40% part-time paternity leave)
Sep. 2017–May 2018	Affiliated with BARC (Basic Algorithms Research Center in Copenhagen), http://barc.ku.dk/
Jan. 2016–Jul. 2018	Postdoctoral researcher in the ERC funded project "Scalable Similarity Search" of Prof. Rasmus Pagh at ITU Copenhagen (3 months 100% paternity leave)
Apr. 2010–Dec. 2015	Research and Teaching Assistant at the Chair of Complexity Theory and Efficient Algorithms (headed by Prof. Martin Dietzfelbinger), Ilmenau University of Technology, Germany

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Education

Apr. 2010–Jun. 2015	Dr. rer. nat. in Theoretical Computer Science (equivalent to a Ph.D.), Ilmenau, University of Technology, Dissertation: On the Analysis of Two Fundamental Randomized Algorithms: Multi-Pivot Quicksort and Efficient Hash Functions, Reviewer: Martin Dietzfelbinger, Rasmus Pagh, Philipp Woelfel. Grade: summa cum laude ("graduated with highest honors")
Oct. 2004 – Mar. 2010	Dipl.-Inf. in Computer Science (equivalent to a Master's degree), Ilmenau, University of Technology, Major: Computer Science, Minor: Mathematics, Thesis: An Alternative Analysis of Cuckoo Hashing with a Stash and Realistic Hash Functions. Grade: 1.2 ("graduated with distinction")

Research Key Metrics

- Citation count: 417*
- H-Index: 10*
- Orchid: http://orcid.org/0000-0002-7212-6476

(*according to https://scholar.google.dk/citations?user=TNJYIYoAAAAJ)

Publications

Editorial work

2020 S. Satoh, L. Vadicamo, A. Zimek, F. Carrara, I. Bartolini, M. Aumüller, B. Jónsson, Rasmus Pagh, *Similarity Search and Applications - 13th International Conference, SISAP 2020*

Journal publications

2022 M. Aumüller, S. Har-Peled, S. Mahabadi, R. Pagh, F. Silvestri, *Sampling a Near Neighbor in High Dimensions - Who is the Fairest of Them All?* ACM Trans. Database Syst. 47(1): 4:1-4:40.

2021 M. Aumüller, S. Har-Peled, S. Mahabadi, R. Pagh, F. Silvestri, *Fair near neighbor search via sampling*, ACM SIGMOD Record 50.

2021 M. Aumüller, M. Ceccarello, *The Role of Local Dimensionality Measures in Benchmarking Nearest Neighbor Search.* Information Systems.

2019 M. Aumüller, E. Bernhardsson, A. Faithfull, *ANN-Benchmarks: A Benchmarking Tool for Approximate Nearest Neighbor Algorithms*, Information Systems.

2018 M. Aumüller, M. Dietzfelbinger, C. Heuberger, D. Krenn, H. Prodinger, *Dual-Pivot Quicksort: Optimality, Analysis and Zeros of Associated Lattice Paths*, Combinatorics, Probability, and Computing. S

2016 M. Aumüller, M. Dietzfelbinger, P. Klaue, *How Good is Multi-Pivot Quicksort?*, ACM Transactions on Algorithms 13(1).

2015 M. Aumüller, M. Dietzfelbinger, *Optimal Partitioning for Dual-Pivot Quicksort*, ACM Transactions on Algorithms 12(2).

2014 M. Aumüller, M. Dietzfelbinger, P. Woelfel, *Explicit and Efficient Hash Families Suffice for Cuckoo Hashing with a Stash*, *Algorithmica (70)*, 2014. Special Issue on Selected Papers from ESA 2012.

Peer-reviewed conference papers

AISTATS 2022	M. Karppa, M. Aumüller, R. Pagh, *DEANN: Speeding up Kernel-Density Estimation using Approximate Nearest Neighbor Search*
EDBT 2022	M. Aumüller, M. Ceccarello, *Implementing Distributed Similarity Joins using Locality Sensitive Hashing*
CCS 2021	M. Aumüller, C. Lebeda, R. Pagh, *Differentially Private Sparse Vectors with Low Error, Optimal Space, and Fast Access*.
PODS 2020	M. Aumüller, R. Pagh, F. Silvestri, *Fair Near Neighbor Search: Independent Range Sampling in High Dimensions*.
SISAP 2020	M. Aumüller, A. Bourgeat, J. Schmurr, *Differentially Private Sketches for Jaccard Similarity Estimation*.
SISAP 2020	M. Aumüller, M. Ceccarello, *Running Experiments with Confidence and Sanity*.
ESA 2019	M. Aumüller, T. Christiani, R. Pagh, M. Vesterli, *PUFFINN: Parameterless and Universally Fast FInding of Nearest Neighbors*.
ALENEX 2019	M. Aumüller, N. Hass, *Simple and Fast BlockQuicksort using Lomuto's Partitioning Scheme*.
SISAP 2019	M. Aumüller, M. Ceccarello, *The Role of Local Intrinsic Dimensionality in Benchmarking Nearest Neighbor Search*. Invited to Information Systems. ♣ *Best Paper Award* ♣
PODS 2018	M. Aumüller, T. Christiani, R. Pagh, F. Silvestri, *Distance-sensitive Hashing*.
SISAP 2017	M. Aumüller, E. Bernhardsson, A. Faithfull, *ANN-Benchmarks: A Benchmarking Tool for Approximate Nearest Neighbor Algorithms*, Invited to Information Systems
SODA 2017	T. D. Ahle, M. Aumüller, R. Pagh, *Parameter-free Locality Sensitive Hashing for Spherical Range Reporting*
AofA 2016	M. Aumüller, M. Dietzfelbinger, C. Heuberger, D. Krenn, H. Prodinger. *Counting Zeros in Random Walks on the Integers and Analysis of Optimal Dual-Pivot Quicksort*.
ICALP 2013	M. Aumüller, M. Dietzfelbinger, *Optimal Partitioning for Dual Pivot Quicksort*.
ESA 2012	M. Aumüller, M. Dietzfelbinger, P. Woelfel, *Explicit and Efficient Hash Families Suffice for Cuckoo Hashing with a Stash*. Invited to Algorithmica.
ESA 2009	M. Aumüller, M. Dietzfelbinger, M. Rink, *Experimental Variations of a Theoretically Good Retrieval Data Structure*.

Peer-reviewed workshop papers

2019	M. Aumüller, M. Ceccarello, *Benchmarking Nearest Neighbor Search: Influence of Local Intrinsic Dimensionality and Result Diversity in Real-World Datasets*

Other

NeurIPS 2021	H. Simhadri, G. Williams, M. Aumüller, M. Douze, A. Babenko, D. Baranchuk, Q. Chen, L. Hosseini, R. Krishnaswamy, G. Srinivasa, S. Subramanya, J. Wang, *Results of the NeurIPS'21 Challenge on Billion-Scale Approximate Nearest Neighbor Search*
MM 2020	Q. Truong, H. Lauw, M. Aumüller, N. Nitta, *Reproducibility Companion Paper: Visual Sentiment Analysis for Review Images with Item-Oriented and User-Oriented CNN*.
SEA 2020	M. Aumüller, *Algorithm Engineering for High-Dimensional Similarity Search Problems (Invited Talk)*.

Theses

2015 *On the Analysis of Two Fundamental Randomized Algorithms: Multi-Pivot Quicksort and Efficient Hash Functions*, Dissertation, TU Ilmenau.

2010 *An Alternative Analysis of Cuckoo Hashing with a Stash and Realistic Hash Functions*, Master's thesis, TU Ilmenau.

Presentations

Invited talks

2020 *Algorithm Engineering for High-Dimensional Similarity Search Problems*, Symposium on Experimental Algorithms (SEA 2020), virtual.

Conference presentations

2020 *Differentially Private Sketches for Jaccard Similarity Estimation*, SISAP 2020, virtual, October 2020.

2020 *Fair Near Neighbor Search: Independent Range Sampling in High Dimensions*, PODS 2020, virtual, June 2020.

2019 *The Role of Local Intrinsic Dimensionality in Benchmarking Nearest Neighbor Search*, SISAP 2019, Newark, October 2019.

2019 *PUFFINN: Parameterless and Universally Fast FInding of Nearest Neighbors*, ESA 2019, Munich, September 2019.

2019 *Benchmarking Nearest Neighbor Search: Influence of Local Intrinsic Dimensionality and Result Diversity in Real-World Datasets*, EDML 2019 (co-located with SDM 2019), Calgary, May 2019.

2018 *Distance-Sensitive Hashing*, PODS 2018, Houston, June 2018

2017 *Parameter-free Locality Sensitive Hashing for Spherical Range Reporting*, SODA 2017, Barcelona, January 2017

2013 *Optimal Partitioning for Dual Pivot Quicksort*, ICALP 2013, Riga, July 2013

2012 *Explicit and Efficient Hash Families Suffice for Cuckoo Hashing with a Stash*, ESA 2012, Ljubljana, September 2012

Invited presentations

2021 *Local Intrinsic Dimensionality and Nearest Neighbor Search*, WSDM 2021, Conference on Web Search and Data Mining, March 2021.
2018 *Recent Advances in Quicksort*, Institute Seminar, University of Padova, October 2018.
2017 *Distance-sensitive Hashing*, Dagstuhl, Seminar 17181, May 2017
2016 *News on Multi-Pivot Quicksort*, Dagstuhl Seminar 16101, March 2016
2015 *Optimal Partitioning for Multi-Pivot Quicksort*, Algorithm seminar, ITU Copenhagen, October 2015
2015 *Strong Randomness Properties of (Hyper-)Graphs Generated by Simple Hash Functions*, Analysis of Algorithms 2015, Strobl, Austria, June 2015
2014 *Optimal Partitioning for Multi-Pivot Quicksort*, Dagstuhl Seminar 14091, February 2014
2011 *Strong Randomness Properties of Graphs and Hypergraphs Generated by Simple Hash Functions*, Research seminar, Ilmenau, December 2011

Workshop presentations

2016 *Multi-Pivot Quicksort: Comparison-Optimal Algorithms and Beyond*, ARCO'16, April 2016
2013 *Optimal Partitioning for Dual Pivot Quicksort*, 66. Theorietag der Fachgruppe Algorithmen und Komplexität, Hannover, Germany, June 2013
2010 *Cuckoo Hashing with a Stash and Realistic Hash Functions*, 60. Theorietag der Fachgruppe Algorithmen und Komplexität, Kiel, Germany, June 2010

Advising

IT University of Copenhagen

PhD students

- 2020–ongoing, Christian Janos Lebeda, co-supervised with Rasmus Pagh.

Master thesis advising

- I. Larsen, A. Madsen, "An Empirical Comparison of Differentially Private Similarity Estimation Techniques", 2022.
- L. Berthelsen, E. Crome, S. Jensen, "Graph-Based Similarity Search Algorithms", 2022.
- E. Lemming, J. Nielsen, O. Schiermer, " $2d$ k-nearest neighbors search using shallow-cuttings", 2022.
- R. Pontoppidan, M. Vagnholm, "Similarity Joins via LSH and LSF", 2021.
- M. Edvardsen, J. Homann, "Privacy-Preserving Similarity Search", 2020.
- M. Kopcik, "Machine Learning Framework for Solving Nearest Neighbor Search", 2020.
- A. Ensing, "Graph-based Similarity Search", 2020.
- M. Drasbeck, "Using Differential Privacy on Danish Data", 2020.
- O. Kristiansen, "Similarity Search in Large Image Data Sets", 2019.
- A. Vosmaer, "Machine Learning Based Indexing Techniques for Finding Approximate Nearest Neighbors", 2019.

- A. Bourgeat, J. Schmurr, "Privacy-Preserving Similarity Search", 2019, **(Paper SISAP 2020)**.
- F. Bakke, S. Petursson, "Locality Sensitive Hashing on the GPU" , 2019.
- F. Buch, A. Lauridsen, "Frequent Item Mining - Introducing a hybrid differential privacy model", 2019.
- K. Nielsen, "Evaluation of improved ANN framework", 2018.
- D. Leszkowicz, "Interactive Data Visualization for a better understanding of Recommender Systems", 2018.
- V. Limbean, "Audio Feature Extraction and Fingerprinting", 2018
- N. Hass, "Design and experimental evaluation of Multi-Pivot BlockQuickSort on Lomuto based partitioning", 2017, **(Paper ALENEX 2019)**.
- R. Dobre, C. Matrakou, R. Themsen, "Image similarity search using Locality Sensitive Hashing (LSH)", 2016

Bachelor thesis advising

- B. Larsen, J. Porsgaard, "Learning a locality sensitive hashing scheme in euclidean space", 2022.
- A. Christensen, I. Matic, "Reproducibility in Algorithm Engineering", 2022.
- T. Poulsen, V. Thomsen, "Sketching Techniques in PUFFINN", 2022.
- C. Rüdinger, G. Brygger, W. Bugge, "Engineering Low-Dimensional Similarity Search", 2021.
- B. Kehler, D. Engggard, "Outlier Detection Using LSH Variants", 2021.
- M. Peterson, "Introduction to the adaptive sorting algorithms Peek Sort and Power Sort in C#", 2019.
- F. Stauning, M. Krøse, "Implementing multi-pivot quicksort algorithms in C#", 2018.

Student project advising

- I. Hemmingsen,"Visualizing data using Python", 2018.
- M. Rasmussen, N. Hass, "Investigating branch-free and equal-element aware multi-pivot quicksort variants", 2016

TU Ilmenau

Master thesis advising

- P. Klaue, "Optimal Partitioning for Multi-Pivot Quicksort", 2014, **(Paper TALG 13)**.

Bachelor thesis advising

- D. Knacker, "Theoretical Considerations in Route Planning Algorithms", 2014.
- A. Chemissov, "Performance Evaluation of Efficient Hashing Methods", 2014.
- A. Seifert, "Modern Algorithms for Route Planning", 2012.

Teaching

At ITU Copenhagen

Spring 2022	*Algorithmic Fairness, Accountability, and Ethics* (graduate level)
Spring 2022	*Algorithmic Problem Solving* (undergraduate level)
Autumn 2021	*Introduction to Programming* (undergraduate level)
Summer 2021	*Algorithms and Data Structures* (undergraduate level)
Spring 2021	*Algorithmic Problem Solving* (undergraduate level)
Autumn 2020	*Applied Algorithms* (graduate level)
Autumn 2020	*Introduction to Programming* (undergraduate level)
Summer 2020	*Algorithms and Data Structures (summer university)* (undergraduate level)
Autumn 2019	*Introduction to Programming* (undergraduate level)
Autumn 2019	*Applied Algorithms* (graduate level)
Autumn 2018	*Introduction to Programming* (undergraduate level)
Autumn 2018	*Applied Algorithms* (graduate level)
Spring 2018	*First-Year Project: Map of Denmark. Visualization, Navigation, Searching, and Route Planning* (undergraduate)
Autumn 2017	*Programming workshop* (graduate level)
Spring 2017	*Algorithm design project* (graduate level)
Autumn 2016	*Programming workshop* (graduate level)
Spring 2016	*Advanced algorithm seminar* (graduate level)

At TU Ilmenau (teaching in German)

2015	*Algorithms and Data Structures**: tutorial Summer 2015
2010–2015	*Efficient Algorithms 2**: tutorial Winter 2010–2015
2010–2015	*Project seminar*: supervised students writing literature papers on topics in algorithms, data structures and complexity theory (13 students supervised)
2010–2014	*Efficient Algorithms**: main instructor in Summer 2012, tutorial Summer 2010–2014
2011, 2013	*Complexity Theory**: tutorial Summer 2011 and 2013
2011–2012	*Approximation Algorithms**: tutorial Winter 2011 and 2012
2010	*Computability and Complexity*: tutorial Winter 2010

As a student T.A.

2006–2007	tutorials for foreign students on introductory programming courses

(* indicates that around 20% of lectures were given as a replacement for the official teacher)

Awards and Prizes

Prizes

Oct. 2015	Awarded "Lehrpreis 2015" from Technische Universität Ilmenau (one out of ten university-wide awards for excellent teaching)
Oct. 2013	Awarded "Lehrpreis 2013" from Technische Universität Ilmenau

*Awards**

Dec. 2020	SIGMOD Research Highlight for PODS 2020 paper (Invited to CACM).
Oct. 2019	Best Paper Award at SISAP 2019.
Dec. 2014	2 Awards: "best tutorial" ("Efficient Algorithms" & "Efficient Algorithms 2")
Dec. 2012	3 Awards: "best lecture" ("Efficient Algorithms") and "best tutorial" ("Efficient Algorithms" & "Efficient Algorithms 2")
Dec. 2011	1 Award: "best tutorial" ("Efficient Algorithms")

(* teaching awards based on mandatory faculty-wide student evaluations)

Affiliations

- Association for Computing Machinery, since 2016

Professional Service

- General Co-Chair of SISAP 2020
- Co-Chair of Reproducibility Track at ACM ICMR 2021 and ICMR 2022
- PC Service: SEA 2018, ESA 2018 (Track B), MMM 2019, ACM MM Reproducibility 2019, EDML 2019, SISAP 2019, LATIN 2022
- Reviewer: WADS 2011, ICALP 2013, ESA 2013, Information Processing Letters, CSR 2016, MFCS 2016, STOC 2017, PODS 2017, Algorithmica 2017, WADS 2017, SODA 2018, ANALCO 2018, Software: Practice and Experience, PPoPP 2018, Artificial Intelligence, ICALP 2019, ESA 2019, Mathematics in Computer Science, SODA 2020, Transactions on Knowledge and Data Engineering, Information Systems 2020, AofA 2020, Euro-Par 2020, PODS 2021, Information Systems 2021, ESA 2021, APPROX-RANDOM 2021, IEEE BigData 2021.
- Coordinator: 2017, Dagstuhl Seminar 17181, "Theory and Applications of Hashing"
- Organizer: ARCO 2018, IT University of Copenhagen
- Co-organizer: 69. Workshop über Algorithmen und Komplexität at TU Ilmenau, 2015
- PhD committees: Nina Mesing Stausholm Nielsen, ITU (2021).
- Local organizer: I help organizing programming events such as "Will Code for Drinks" and "LilleKat" at ITU (headed by Thore Husfeldt). On a regular basis, I presented my research work and practical applications of algorithms at workshops for pupils and at open house days. Moreover, I organized and fund-raised the "summer festival" of the faculty in Ilmenau in 2015.
- Internal Committee work at ITU: SD 2019/2022 admission committee, CS department computing resources, CS reference group for relocation, ITU representative at HPC forum Denmark, CS representative SPS students

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Invited workshop participation

- Dagstuhl Seminars on “Data Structures and Advanced Models of Computation on Big Data” in 2014 & 2016
- Analysis of Algorithms 2015, Strobl (by invitation only in odd years)

Languages

- German (native), English (fluent), Danish (conversational)
- Basic knowledge in Russian, Swedish, Japanese
