Matti Karppa

Senior Lecturer

Gothenburg, Sweden

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Education

2020-02-14 | **Doctor of Science (Technology)**, Aalto University, Espoo, Finland
Computer Science

2020-02-05 | **Master of Science**, University of Helsinki, Helsinki, Finland
Mathematics teacher education

2014-08-29 | **Master of Science (Technology)**, Aalto University, Espoo, Finland
Computer Science

2014-01-31 | **Master of Science**, University of Helsinki, Espoo, Finland
Computer Science

2006-06-03 | **Matriculation Examination**, Vääksyn Yhteiskoulu, Asikkala, Finland
General upper secondary school certificate

Language skills

Finnish: Native **English:** Fluent **Swedish:** Competent

Work Experience

02/2023–Present | **Senior lecturer**
University of Gothenburg
A senior lecturer at the division of Data Science and Artificial Intelligence, colocated with Chalmers University of Technology.

06/2020–01/2023 | **Postdoctoral researcher**
IT University of Copenhagen
A postdoc in the algorithms group, working on kernel density estimation and counting distinct elements, with implementation in C++ and Python.

01/2020–06/2020 | **Teacher**
Nurmijärven Yhteiskoulu
Mathematics and physics teacher, teaching grades 7–9, including responsibilities as a class supervisor.

02/2019–12/2019 | **Software developer**
Vincit Oyj
Software development consultant. Most important technologies within data science and Python (such as NumPy, Pandas, matplotlib etc.) and C#.

09/2014–01/2019 | **Postgraduate researcher**
Aalto University
Doctoral student within algorithms, inlcluding *similarity search*, *symmetry breaking*, and *Boolean matrix multiplication*, with implementation using technologies such as C++, Python, MPI, and CUDA.

06/2010–08/2014 | **Undergraduate researcher**
Aalto University
Research assistant within Content-Based Image Retrieval group, implementing research software in C++/OpenCV for automatic annotation of Finnish Sign-Language Videos within an interdisciplinary project.

07/2007–08/2009 | **System specialist**
Finnish Food Safety Authority Evira
First civilian serviceman, then full-time summer worker and part-time in spring at the IT department. User support and workstation and server administration in a Microsoft Server 2003 AD and Exchange environment.

Teaching Experience

01/2024–05/2025 | **Master theses**, University of Gothenburg / Chalmers University of Technology
Supervisor / Examiner
Supervised a total of five master theses on various topics related to algorithms engineering, application of machine learning in data science education etc. In addition, examined four master theses on various topics related to data science and programming languages.

03/2023–06/2025 | **Computational tehcniques for large scale data**, University of Gothenburg / Chalmers University Technology
Lecturer/Examiner
In the springs of 2023–2025, I lectured and examined a course that addressed parallel programming and data structures and algorithms pertaining to the processing of large-scale data. The course consisted of lectures and assignments where students worked in groups and implemented algorithms in Python to be executed in a cluster environment. Topics addressed included cache use, multiprocessing in Python, the MapReduce paradigm, Spark, and various algorithms and data structures (hashing, hyperloglog, spatial data structures etc.). In each of the iterations, the course was attended by ca. 90 students. I have actively revised the course and especially its asssignments throuhgout the iterations, including updating it to make use of our new compute cluster that was acquired in 2024.

01/2024–03/2025 | **Introduction to Data Science & AI**, University of Gothenburg / Chalmers University of Technology
Lecturer/Examiner/Coordinator
In 2024 and 2025, I taught a very large introductory data science course with ca. 250 students a time, with very variable backgrounds across the two universities. I also assumed the role to coordinate course development across multiple course instances, as the course is lectured four times a year with a total of over 1,000 students taking the course a year. Due to the size of the course, I led a large teaching team that consisted of technical lecturers, postdocs, and a large number of teaching assistants who were PhD or MSc students. I also led course development: for the 2024 instance, I restructured the course to follow a textbook, revised all course assignments, and in 2025 adopted CodeGrader, an automatic assessment system, and in autumn 2025 introduced an exam to the course.

08/2023–10/2024 | **Introduction to Data Science**, University of Gothenburg
Lecturer/Examiner
I gave an introductory course in data science to students in the "Applied Data Science" program at GU in autumns of 2023 and 2024. The students had very variable background, so the course included basic math, such as sets and functions, and basic probability theory, together with introductory statistics, introduction to basic Python tools in data science, and some basic theoretical tools such as k-means, k-NN classifiers, and linear regression. The course was attended by ca. 30 students.

09/2021–01/2023 | **Applied Algorithms**, IT University of Copenhagen
Lecturer
In 2021 and 2022, I gave 50% and 100% of the lectures, respectively, in the Applied Algorithms course, targeted at MSc. students in the Software Design program. The course aims at practical algorithm engineering work, where the students are expected to implement and experiment in practice algorithms that they have been taught in theory. The course is structured around mandatory course assignments that are done in groups, followed by an exam assignment also done in groups and an oral exam. In addition to giving lectures, I also gave exercise sessions, organized as self-directed lab sessions, oversaw two Teaching Assistants, updated and prepared new course assignments and a new exam, and created automatically-graded computer exercises to assist the students in their learning.

01/2022–06/2022 | **Master theses**, IT University of Copenhagen
Supervisor
I supervised two masters' theses together with Associate Professor Riko Jacob. Nominally I was the co-supervisor with a 60% contribution. In practice, I supervised one of the theses fully and had little contribution to the other. However, I was one of the three examiners for both theses.

01/2020–05/2020 | **Teacher**, Nurmijärven Yhteiskoulu
Mathematics and physics (Grades 7–9)
I worked as a mathematics and physics teacher, as a temporary substitute teacher for the spring. I had full responsibility of all teaching activities for a large number of students in grades 7–9 (ages 13–16), preparing, teaching, and grading mathematics and physics courses, including all aspects of school-work from supervising physics laboratory sessions to teaching elementary programming in Python. I also worked as a class supervisor for a class in 7th grade.

01/2015–05/2018 | **Programming II (Scala)**, Aalto University
Head assistant
I was the head assistant, in charge of some course organization and gave occasional exercises in the course "Programming II", a first-year level programming course (Scala).

01/2014–05/2014 | **Programming II (Scala)**, Aalto University
Teaching Assistant
I gave exercise sessions in a first-year programming course (Scala).

09/2013–12/2013 | **Digital Image Processing**, Aalto University
Teaching Assistant
I gave exercise sessions in a master's level (formerly bachelor's level) course in digital image processing.

Teaching Qualifications

2024–2025 | **University pedagogical studies**, University of Gothenburg
Courses
University pedagogical studies, corresponding to 14 weeks of study, given by the Unit for Pedagogical Development and Interactive Learning (PIL), for the qualification of a docent: PIL101 "Basic course", PIL102: "Subject field pedagogy", PIL103: "Applied analysis", and PIL201: "Supervision in postgraduate programs".

2022 | **Pedagogical courses**, IT University of Copenhagen
Courses
Pedagogical courses offered by the learning support: "Project and thesis supervision" and "Exam seminar".

2017–2018 | **Pedagogical studies for teachers**, University of Helsinki
Minor subject
Pedagogical qualification for working as a teacher, worth 60 ECTS. I also have 120 ECTS qualificiation for working as a mathematics or computer science teacher, and a 60 ECTS qualification for working as a physics teacher.

2014–2015 | **Scype – Aalto SCI pedagogical training**, Aalto University
Courses
Pedagogical training consisting of two modules: introduction to teaching at Aalto (5 ECTS) and Course Planning (5 ECTS).

10/2013 | **Tools for teaching training**, Aalto University
Course
A one-day long teaching training event aimed at teaching assistants.

Research Funding

06/2014–06/2018 | **Helsinki Doctoral Education Network in Information and Communications Technology (HICT)**
Doctoral funding
Four-year funding for pursuing a doctoral degree at Aalto University.

Technical Skills

Programming languages	C++	A lot of work experience
	Python	A lot of work experience
	C#	Some work experience
	Matlab	Some work experience
	C	Some work experience
	Fortran	Basics, a little work experience
	Scala	Basics, some teaching experience
	Java	Basics, some teaching experience
	Shell scripts	Some experience
	QBasic, CBM BASIC	Some hobbyist experience
	Rust	Basics
	x86 ASM	Basics
	MOS 6510 ASM	Basics
Libraries	NumPy	Work experience
	Pandas	Work experience
	matplotlib	Work experience
	OpenCV	Work experience
	MPI	Basics, some implementation experience
	CUDA	Basics, some implementation experience
	Spark	Basics, some teaching experince
	Miscellaneous:	GMP, nauty, Eigen, MKL, among others
Operating systems	GNU/Linux	Power user, some admin experience
	Microsoft Windows	Power user, some admin experience
	Mac OS X	Power user
Tools	Typesetting	LaTeX, typst
	Office tools	Excel, PowerPoint, Word etc.
	Text editors	Emacs, Visual Studio Code etc.
	Development tools	git, CVS, GCC, CLang, make, CMake, GDB, etc.
	HPC cluster stuff	Slurm, Docker

Publications

[1] M. Karppa and R. Pagh, "HyperLogLogLog: Cardinality Estimation With One Log More," in *Proceedings of the 28th ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD 2022)*, 2022.

[2] M. Karppa, M. Aumüller, and R. Pagh, "DEANN: Speeding up Kernel-Density Estimation using Approximate Nearest Neighbor Search," in *Proceedings of the 25th International Conference on Artificial Intelligence and Statistics (AISTATS 2022)*, 2022.

[3] M. Karppa, "On Bilinear Techniques for Similarity Search and Boolean Matrix Multiplication," Espoo, Finland, 2020. [Online]. Available: https://aaltodoc.aalto.fi/handle/123456789/42426

[4] M. Karppa, P. Kaski, J. Kohonen, and P. Ó. Catháin, "Explicit Correlation Amplifiers for Finding Outlier Correlations in Deterministic Subquadratic Time," *Algorithmica*, vol. 82, no. 11, pp. 3306–3337, 2020, doi: 10.1007/s00453-020-00727-1.

[5] T. Junttila, M. Karppa, P. Kaski, and J. Kohonen, "An Adaptive Prefix-Assignment Technique for Symmetry Reduction," *Journal of Symbolic Computation*, vol. 99, pp. 21–49, 2020, doi: 10.1016/j.jsc.2019.03.002.

[6] M. Karppa and P. Kaski, "Engineering Boolean Matrix Multiplication for Multiple-Accelerator Shared-Memory Architectures," *CoRR*, 2019, [Online]. Available: http://arxiv.org/abs/1909.01554

[7] M. Karppa and P. Kaski, "Probabilistic Tensors and Opportunistic Boolean Matrix Multiplication," in *Proceedings of the Thirtieth Annual ACM-SIAM Symposium on Discrete Algorithms (SODA 2019)*, Philadelphia, PA, USA: Society for Industrial, Applied Mathematics, 2019, pp. 496–515. doi: 10.1137/1.9781611975482.31.

[8] M. Karppa, P. Kaski, and J. Kohonen, "A Faster Subquadratic Algorithm for Finding Outlier Correlations," *ACM Trans. Alg.*, vol. 14, no. 3, p. Article~31, 2018, doi: 10.1145/3174804.

[9] T. Junttila, M. Karppa, P. Kaski, and J. Kohonen, "An Adaptive Prefix-Assignment Technique for Symmetry Reduction," in *Theory and Applications of Satisfiability Testing – SAT 2017*, Cham, Switzerland: Springer International Publishing, 2017, pp. 101–118. doi: 10.1007/978-3-319-66263-3_7.

[10] M. Karppa, P. Kaski, J. Kohonen, and P. Ó. Catháin, "Explicit correlation amplifiers for finding outlier correlations in deterministic subquadratic time," in *Proceedings of the 24th Annual European Symposium on Algorithms (ESA 2016)*, Dagstuhl, Germany: Schloss Dagstuhl–Leibniz-Zentrum fuer Informatik, 2016, pp. 1–17. doi: 10.4230/LIPIcs.ESA.2016.52.

[11] M. Karppa, P. Kaski, and J. Kohonen, "A Faster Subquadratic Algorithm for Finding Outlier Correlations," in *Proceedings of the 27th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA 2016)*, Philadelphia, PA, USA: Society for Industrial, Applied Mathematics, 2016, pp. 1288–1305. doi: 10.1137/1.9781611974331.ch90.

[12] M. Karppa, V. Viitaniemi, M. Luzardo, J. Laaksonen, and T. Jantunen, "SLMotion~–~An extensible sign language oriented video analysis tool," in *Proceedings of 9th Language Resources and Evaluation Conference (LREC 2014)*, N. C. (Conference Chair), K. Choukri, T. Declerck, H. Loftsson, B. Maegaard, J. Mariani, A. Moreno, J. Odijk, and S. Piperidis, Eds., Reykjavík, Iceland: European Language Resources Association, May 2014. [Online]. Available: http://www.lrec-conf.org/proceedings/lrec2014/pdf/209_Paper.pdf

[13] V. Viitaniemi, T. Jantunen, L. Savolainen, M. Karppa, and J. Laaksonen, "S-pot – a benchmark in spotting signs within continuous signing," in *Proceedings of 9th Language Resources and Evaluation Conference (LREC 2014)*, N. C. (Conference Chair), K. Choukri, T. Declerck, H. Loftsson, B. Maegaard, J. Mariani, A. Moreno, J. Odijk, and S. Piperidis, Eds., Reykjavík, Iceland: European Language Resources Association, May 2014. [Online]. Available: http://www.lrec-conf.org/proceedings/lrec2014/pdf/440_Paper.pdf

[14] V. Viitaniemi, M. Karppa, and J. Laaksonen, "Experiments on Recognising the Handshape in Blobs Extracted from Sign Language Videos," in *Proceedings of 22nd International Conference on Pattern Recognition (ICPR 2014)*, Los Alamitos, CA, USA: IEEE Computer Society, Aug. 2014. doi: 10.1109/ICPR.2014.446.

[15] M. Luzardo, V. Viitaniemi, M. Karppa, J. Laaksonen, and T. Jantunen, "Estimating Head Pose and State of Facial Elements for Sign Language Video," in *Proceedings of the 6th Workshop on the Representation and Processing of Sign Languages: Beyond the Manual Channel (LREC 2014)*, Reykjavík, Iceland: European Language Resources Association, May

2014. [Online]. Available: http://www.lrec-conf.org/proceedings/lrec2014/workshops/LREC2014Workshop-SignLanguage%20Proceedings.pdf

[16] V. Viitaniemi, M. Karppa, and J. Laaksonen, "2D Appearance Based Techniques for Tracking the Signer Configuration in Sign Language Video Recordings," in *Proceedings of 11th International Conference on Image Analysis and Recognition (ICIAR 2014)*, Berlin, Germany, 2014, pp. 29–38. doi: 10.1007/978-3-319-11755-3_4.

[17] T. Jantunen, V. Viitaniemi, M. Karppa, and J. Laaksonen, "The head as a place of articulation: From automated detection to linguistic analysis," in *Proceedings of 11th Theoretical Issues in Sign Language Research conference (TISLR 2013)*, Jul. 2013.

[18] V. Viitaniemi, M. Karppa, J. Laaksonen, and T. Jantunen, "Detecting Hand-Head Occlusions in Sign Language Video," in *Proceedings of the 18th Scandinavian Conference on Image Analysis*, in LNCS, vol. 7944. Berlin, Germany: Springer, Jun. 2013, pp. 361–372. doi: 10.1007/978-3-642-38886-6_35.

[19] M. Luzardo, M. Karppa, J. Laaksonen, and T. Jantunen, "Head Pose Estimation for Sign Language Video," in *Proceedings of the 18th Scandinavian Conference on Image Analysis*, in LNCS, vol. 7944. Berlin, Germany: Springer, Jun. 2013, pp. 349–361. doi: 10.1007/978-3-642-38886-6_34.

[20] M. Karppa, T. Jantunen, V. Viitaniemi, J. Laaksonen, B. Burger, and D. De Weerdt, "Comparing computer vision analysis of signed language video with motion capture recordings," in *Proceedings of 8th Language Resources and Evaluation Conference (LREC 2012)*, Istanbul, Turkey: European Language Resources Association, May 2012, pp. 2421–2425. [Online]. Available: http://www.lrec-conf.org/proceedings/lrec2012/pdf/321_Paper.pdf

[21] M. Karppa, T. Jantunen, M. Koskela, J. Laaksonen, and V. Viitaniemi, "Method for visualisation and analysis of hand and head movements in sign language video," in *Proceedings of the 2nd Gesture and Speech in Interaction conference (GESPIN 2011)*, Bielefeld, Germany: University of Bielefed, 2011. [Online]. Available: http://coral2.spectrum.uni-bielefeld.de/gespin2011/final/Jantunen.pdf