Mirko Klukas, Ph.D.

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Education

Apr 2009 - May 2012	**Ph.D.** Mathematics
	University of Cologne – Cologne, Germany
	Scholarship of the German Research Foundation • Focus: Contact & Symplectic Topology
Jan 2003 - Dec 2008	**M.S.** Mathematics
	University of Cologne – Cologne, Germany
	Thesis awarded with a prize of the German Mathematical Society • Minor: Graph Theory & Theoretical Computer Science • Graduated with distinction
Jul 2010 - Jan 2011	**Guest-doctoral Fellow** Mathematics
	Georgia Institute of Technology – Atlanta GA, USA
	Scholarship of the German Academic Exchange Service

Awards & Scholarships

Apr 2009 - Apr 2012	Research scholarship, German Research Foundation
Jul 2010 - Jan 2011	Research scholarship, German Academic Exchange Service
Oct 2009	Award for Master Thesis, German Mathematical Society

Publications

AI / Computational Neuroscience:

1. **Fragmented spatial maps from surprisal: state abstraction and efficient planning**, with S. Sharma, Y. Du, T. Lozano-Perez, L. Kaelbling, and I. Fiete (2022, under review).
2. **Flexible representation of higher-dimensional cognitive variables with grid cells**, with M. Lewis, and I. Fiete, PLOS Comput. Biol. (2020), 13 pages.
3. **Efficient inference in structured spaces**, with H. Sanders, M. Wilson, S. Sharma, and I. Fiete (2020), 1 page.
4. **A framework for intelligence and cortical function based on grid cells in the neocortex**, with J. Hawkins, M. Lewis, S. Purdy, and S. Ahmad, Front. Neural Circuits 12 (2019), 14 pages.

Mathematics:

1. **Nested open books and the binding sum**, with S. Durst, Osaka J. Math. 58 (2021), 33 pages.
2. **Open books and exact symplectic cobordisms**, Internat. J. Math. 29 (2018), 19 pages.
3. **Open book decompositions of fibre sums in contact geometry**, Algebr. Geom. Topol. 16 (2016), 25 pages.
4. **Computing the Thurston-Bennequin invariant in open books**, with S. Durst and M. Kegel, Acta Math. Hungar. 150 (2016), 15 pages.
5. **The fundamental group of the space of contact structures on the 3-torus**, with H. Geiges, Math. Res. Lett. 21 (2014), 6 pages.
6. **On prolongations of contact manifolds**, with B. Sahamie, Proc. Amer. Math. Soc. 141 (2013), 7 pages.
7. **Isotopy classification of Engel structures on circle bundles**, with B. Sahamie, arXiv preprint (2012), 13 pages.

Research & Working Experience

Nov 2021 - Feb 2022	**Data Science Consultant** DeFi / Math. Modeling HeartRithm Technologies – Cheyenne WY, USA I supported Heartrithm on their data science and modeling front as an independent contractor • Focus: Modeling and optimizing liquidity provision in Uniswap v3 Liquidity Pools • Analysis of perpetual swap arbitrage opportunities ("perpetual carry trades")
Apr 2019 - Oct 2021	**Postdoctoral Researcher** AI / ML / Comp. Neurosci. MIT – Department of Brain and Cognitive Sciences – Cambridge MA, USA Focus: Localization and planning in the hippocampal formation and how this can inform us about general cognitive computations and intelligence • SLAM with recurrent networks • Neural data analysis (TDA, low-dimensional embeddings) • Representation of cognitive spaces
Nov 2017 - Mar 2019	**Research Scholar** AI / ML / Comp. Neurosci. Numenta – Redwood City CA, USA Role emerged from a month long research visit in Nov 2016 • Focus: Spatial representations in the brain, and their role in more general cognitive computations and intelligence • Relating sparse coding and information-theoretic concepts • Formal framework for Numenta's sequence memory from a compression perspective
Oct 2015 - Oct 2017	**Postdoctoral Researcher** Mathematics / ML Institute of Science and Technology Austria – Klosterneuburg, Austria Focus: Combination of mathematics and computer science • TDA and Topological cluster methods • Sparse coding • Variable order Markov models
Sep 2014 - Sep 2015	**Postdoctoral Researcher** Mathematics University of Cologne – Cologne, Germany Focus: Contact and symplectic topology • Low-dimensional topology • Computational topology
Mar 2013 - Jan 2014	**Technology and Management Consulting** Accenture – Düsseldorf, Germany I was a member of the IT Strategy department, with a focus on digital strategies and technology trends.

Skills

Coding	Python (incl. Pytorch, Jupyter) • Julia (incl. Gen) • Javascript
ML	Transformers (LLMs) • Diffusion Models • Recurrent networks (incl. Generative Temp. Models, Cont. time NN, Attractor NN) • Auto-encoder (Variational, Sparse) • SLAM • Probabilistic Programming (incl. Seq. Monte Carlo, Bayesian Nonparametrics, Belief Prop.)
Coursera Certificates	Neural Networks for Machine Learning • Deep Learning Specialization: ◦ Sequence Models ◦ Convolutional Neural Networks ◦ Structuring Machine Learning Projects ◦ Improving Deep Neural Networks ◦ Neural Networks and Deep Learning • Visual Perception and the Brain • Computational Neuroscience • The Brain and Space
Misc	**Hacker School** (Feb 2014 - Apr 2014) Three-month, free, self-directed, educational retreat for intellectually curious people who want to get better at programming, New York City, USA **Civilian Service** (Oct 2001 - Jul 2002) Full-time, individual care of an autistic child at a school for children with special needs, Leverkusen, Germany