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Abel Jansma**URL**

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Physicist who is passionate about using machine learning, causal analysis, and high-performance computing to understand emergent structures in complex systems. I thrive in interdisciplinary teams at the interface of theory, experiment, and computation.

EXPERIENCE**Postdoctoral Researcher | Max Planck Institute for Mathematics in the Sciences | GER Sep 2023 - Present**

- In the *Geometry and Complex Systems* group of Jürgen Jost, I work on higher-order information theory, (quantum) machine learning, and applications to biology.
- Affiliated with Quantum Informatics at the University of Edinburgh to study parametrised quantum circuits.
- Deployed quantum machine learning code on QVMs (pyQuil, Qiskit) and QPUs (AWS Braket).

Postdoctoral Researcher | University of Edinburgh | UK Oct 2022 - July 2023

- Combined machine learning, generative AI, and causal inference to construct hypergraphs of genetic interactions and discovered novel and rare cell identities in populations of up to 100k transcriptomes.
- Inventor and lead R&D of the *STATOR* software package, in an interdisciplinary team across physics, biology, and informatics, combining fundamental research with biomedical applications.

Information Officer | SciPost | NL Oct 2017 - July 2018

- Expanded the editorial board, profiling and contacting potential new editors.

Junior Editor | SPUI25 | NL Feb 2017 - July 2017

- Co-organised and presented monthly academic & cultural events for a broad audience.

Distillation Engineer | Mediamatic | NL Sep 2016 - Feb 2017

- Designed, built, and demonstrated a bespoke 30 litre vacuum still for artistic and olfactory research.

EDUCATION**PhD in Biomedical AI | University of Edinburgh | UK Sep 2018 - Dec 2022**

- Thesis: *Higher-order interactions in single-cell gene expression: Towards a cybergenetic semantics of cell state*
- Supervised by C. Ponting (Inst. of Genetics and Cancer), L. Del Debbio (Higgs Centre for Theor. Phys.), and A. Khamseh (School of Informatics).
- Graduated from the *Academy for PhD Training in Statistics* at the universities of Cambridge and Oxford.

MSc Theoretical Physics | University of Amsterdam | NL Sep 2015 - July 2018

- Thesis: *E_8 symmetry structures in the Ising model* (supervised by B. Nienhuis)
- Visited the Niels Bohr Institute in Copenhagen, Denmark (Feb to Aug 2016), to study nonequilibrium physics and the physics of machine learning.

BSc Physics and Astronomy | University of Amsterdam | NL Sep 2012 - July 2015

- Graduated with Honours/Cum Laude and a minor in Computational Science.

Propedeuse in Art and Technology | HKU University of the Arts | NL Sep 2011 - July 2012

- Art installations on collective behaviour, exhibited in galleries & festivals in the Netherlands, Germany, and Finland.

SELECTED PUBLICATIONS & TALKS

Articles

- Jansma et al (2024) - Decomposing Information on the Free Distributive lattice (forthcoming)
- Jansma, A (2024) - A Unified Approach to Higher-order Structure in Complex Systems (forthcoming)
- Jansma, A (2024) - Superdense Coding and Stabiliser Codes with Ising-coupled Entanglement
- Jansma et al. (2023) - High Order Expression Dependencies Finely Resolve Cryptic States and Subtypes in Single Cell Data (under review at *Molecular Systems Biology*)
- Jansma, A (2023) - Higher-Order Interactions and Their Duals Reveal Synergy and Logical Dependence beyond Shannon Information - *Entropy*, 25(4), 648.
- Jansma, A (2023) - A Compositional Game to Fairly Divide Homogeneous Cake (under review at *JAIR*)

Conferences

- Higher-order in-and-outeractions - DEMICS23, GER, 2023 (talk)
- A compositional game to fairly divide homogeneous cake - Applied Category Theory 2023 (poster)
- Model-free estimation of higher-order interactions - CSHL Biology of Genomes conference, USA, 2021 (poster)
- Higher-order interactions in single-cell expression data - European Mathematical Genetics Meeting, FR, 2021 (talk)
- Higher-order interactions in single-cell expression data - CSHL Network Biology conference, USA, 2021 (poster)

Invited Talks

- A unified approach to higher-order structure in complex systems - University of Leipzig, GER, 2024
- The information theory of higher-order interactions - UvA Institute for Advanced Studies, NL, 2023
- Complex networks in the mouse brain - IGC Biomed. Genomics, UK, 2021
- Searching for strange loops in mouse brains - Math. Quantum Physics Seminar, University of Innsbruck, AT, 2021
- Higher-order information lattices - Math. Quantum Physics Seminar, University of Innsbruck, AT, 2021

HONOURS & AWARDS

Protocol Fellowship Grant | Ethereum Foundation | GER

Nov 2022 - March 2023

- Research grant in collaboration with the Robust Incentives group and the Institute for Categorical Cybernetics.
- We use category theory to model the flow of information and value in decentralized systems.

Science Communication Grant | Genetics Society | UK

April 2019

- One of 10 (post-)doctoral researchers nationwide to be awarded funding for science communication training.

Technology Scholarship | ASML | NL

Sep 2015 - Sep 2017

- One of 25 graduate students nationwide awarded a two-year professional development scholarship, focused on leadership in technology.

VOLUNTEERING

Co-host | Computational Biology Journal Club

Feb 2019 - March 2020

- Hosted at the MRC Institute of Genetics and Cancer.

Beekeeper | Anna's Tuin en Ruigte

Oct 2017 - July 2018

- Beekeeper at a public permaculture garden.

Reader | VoorleesExpress

Nov 2016 - Nov 2017

- I read books to children to stimulate language development and promote reading.

Committee member | BetaBreak

Dec 2014 - Jan 2016

- Moderated and organised public debates on science & society at Amsterdam Science Park.

LANGUAGES

Natural

Dutch (native), English (fluent), German (fluent), French (basic)

Programming

Python (SciPy, PyTorch, Qiskit, *etc.*), R, Nextflow, SGE, Git, Haskell, Arduino (C++)