

Uri Cohen

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INTRODUCTION

ABOUT ME

I am an aspiring scientist in the field of computational neuroscience, interested in developing theories on the dynamics of learning and memory in the brain and putting them to the test through collaboration with experimentalists. I have a strong mathematical background and hands-on experience with advanced statistical physics and computer science methods, applied to analyze problems and experimental results from neuroscience and machine learning.

PHD THESIS

Title: *Analysis of invariant object representations through linear classification of manifolds.*

Advisor: Prof. Haim Sompolinsky

In my PhD thesis, I used statistical physics methods to analyze neuronal responses to objects and measure the properties important for linear object classification. Those are geometric properties of object manifolds which I use to shed light on object representations in artificial deep networks and the brain and how it changes across levels of processing.

RESEARCH INTERESTS

- Population coding and manifold representation of sensory information.
- Biological learning and its relation to memory storage and recall.
- Neural implementation of world models and its application to reinforcement learning.
- Biological alternatives to error backpropagation, implementation of gradient descent.
- Predictive coding and its relation to learning and memory.

EDUCATION AND RESEARCH

2023 – 2024 Postdoctoral visiting fellow at the University of Cambridge

with Professor Máté Lengyel at the Computational and Biological Learning lab.

2022 Postdoctoral fellow at the Hebrew University of Jerusalem

with Professor Haim Sompolinsky at the Edmond & Lily Safra Center for Brain Sciences.

2011 – 2021 PhD at the Hebrew University of Jerusalem

PhD program in *Brain Sciences: Computation and Information Processing*, at the Edmond & Lily Safra Center for Brain Sciences.

2002 – 2005 BSc at the Hebrew University of Jerusalem

Graduated Summa Cum Laude a double-major degree in Mathematics and Cognitive sciences.

INDUSTRY EXPERIENCE

2007 – 2010 Senior Team Lead and Senior Software Developer at Microsoft R&D

Leading a team of 4 software developers and handling all professional aspects: mentoring and guiding professional growth, project management, and technical leadership.

2005 – 2007 Senior Software Developer at Kidaro (an Israeli start-up)

The leading technical person from project inception and building the company's work processes, through design and implementation of a complete product, to being acquired by Microsoft.

AWARDS

- 2022 Recipient of the Blavatnik Cambridge Postdoctoral Fellowship.
- 2011 Recipient of the Hebrew University Rector's award (equivalent to 1st in class).
- 2005 Graduated *Summa Cum Laude* (average grade 97.2) a BSc at the Hebrew University.
- 2004-5 *Amirim Nature* excellence program for Hebrew University students.
- 2004 Recipient of the Hebrew University Rector's award (equivalent to 1st in class).
- 2003 Recipient of the Hebrew University Rector's award (equivalent to 1st in class).
- 1995 *Gur Arye prize* for high-school graduation projects for my work on *Statistical analysis and game theory of the mastermind game*.

ACTIVITIES

- Conferences talks:
 - Physics for Deep Learning (Tel Aviv, Israel, June 2024, invited speaker)
 - Cambridge Memory Meeting 2024 (Cambridge, UK, May 2024)
 - International Workshop on Learning and Information Theory 2023 (Shenzhen & Hong Kong, China, July 2023, invited speaker)
- Teaching experience: served seven years as a teaching-assistant of the following courses:
 - *Statistical Physics of learning and Memory* (introductory seminar for physics students): mentoring students in preparing their talks and giving several lectures.
 - *Statistical mechanics of spin glasses and neural networks*: giving several lectures.
 - *Topics in the Theory of Deep Learning*: a weekly lecture and preparing exercises.
- Co-organizer of the *Deep Learning Journal Club*, at the Jerusalem deep-learning center.
- Reviewer for conferences:
 - *Computational and Systems Neuroscience (COSYNE)*
 - *Conference on Neural Information Processing Systems (NeurIPS)*
 - *International Conference on Machine Learning (ICML)*
 - *International Conference on Learning Representations (ICLR)*
- Reviewer for journals:
 - American Physical Society's *Physical Review Letters (PRL)*, *Physical Review X life (PRX life)*, and *Physical Review E (PRE)*
 - *Journal of Machine Learning Research (JMLR)*
 - *Transactions on Machine Learning Research (TMLR)*
 - *IEEE Transactions on Neural Networks and Learning Systems*
- Program committee member for workshops:
 - *NeurIPS workshop on Symmetry and Geometry in Neural Representations*
- Extensive experience with neural data analysis, including: [Freiwald & Tsao 2010](#), [Alme, et al. 2014](#), [Majaj, Hong, et al. 2015](#), [Cohen, et al. 2017](#), [Stringer, Pachitariu, et al. 2019](#), [Reber, et al. 2019](#), [Malezieux, et al. 2020](#), [Sheintuch, et al. 2023](#).

SKILLS

- Holds a broad perspective on the field of computational neuroscience.
- Thorough, down-to-details approach.
- Passion for teaching, extensive experience.
- Welcomes feedback and criticism.
- Believes in experimental testing of theory, collaboration with experimentalists.
- Masters advanced mean-field methods from statistical physics (replica and cavity methods, message passing, kernel methods, KKT, RMT).
- Superb software engineering skills (fluent with C/C++/Python/MATLAB).
- Experience with deep learning tools, numerical methods, and large-scale simulations.

PUBLICATIONS

- **Cohen, U.**, Rodriguez, R. M., Paulsen, O., & Lengyel, M. (2024). *A theory of memory stability in hippocampal area CA3*. COSYNE 2024, poster presentation.
- **Cohen, U.**, & Sompolinsky, H. (2022). *Soft-margin classification of object manifolds*. Physical Review E, 106(2), 024126.
- Froudarakis, E., **Cohen, U.**, Diamantaki, M., Walker, E. Y., Reimer, J., Berens, P., Sompolinsky, H., & Tolias, A. S. (2020). *Object manifold geometry across the mouse cortical visual hierarchy*. bioRxiv.
- **Cohen, U.**^{*}, Chung, S. ^{*}, Lee, D. D., & Sompolinsky, H. (2020). *Separability and geometry of object manifolds in deep neural networks*. Nature communications, 11(1), 1-13.
- **Cohen, U.**, Chung, S., Lee, D. D., Freiwald, W., Tsao, D., & Sompolinsky, H. (2019). *Geometric properties of face representations in the macaque face patch system and deep neural networks*. COSYNE 2019, poster presentation.
- Chung, S., **Cohen, U.**, Sompolinsky, H., & Lee, D. D. (2018). *Learning data manifolds with a cutting plane method*. Neural computation, 30(10), 2593-2615.
- **Cohen, U.**, & Sompolinsky, H. (2014). *Computational benefits of sensory expectation cancellation*. ISFN 2014, poster presentation.
- Mattioni, M., **Cohen, U.**, & Le Novère, N. (2012). *Neuronvisio: a graphical user interface with 3d capabilities for neuron*. Frontiers in neuroinformatics, 6, 20.

REFERENCES

- **Professor Haim Sompolinsky**: Center for Brain Science, *Harvard*; Edmond & Lily Safra Center for Brain Sciences, *The Hebrew University of Jerusalem*. haim@fiz.huji.ac.il
- **Professor Daniel D. Lee**: Tisch University Professor of Electrical and Computer Engineering, *Cornell Tech*; Executive Vice President, *Samsung Research* ddl46@cornell.edu
- **Professor Máté Lengyel**: Computational and Biological Learning lab, Department of Engineering, *University of Cambridge*. m.lengyel@eng.cam.ac.uk

* Equal contribution co-first authors