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, with possible applications to machine learning. I have a strong mathematical background and hands-on experience with advanced methods from statistical physics and computer science 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 encoding and usage.
- 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 **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 (the highest academic award).
- 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.
- 2003 Recipient of the Hebrew University Rector's award.
- 1995 *Gur Arye prize* for high-school graduation projects for my work on *Statistical analysis and game theory of the mastermind game*.

ACTIVITIES

- 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 Sociaty's Physical Review E (PRE)*
  - *Journal of Machine Learning Research* (*JMLR)*
  - *IEEE Transactions on Neural Networks and Learning Systems*
- Program committee member for workshops:
  - *NeurIPS workshop on Symmetry and Geometry in Neural Representations*
- Industry-level software developer skills and experience in using deep learning tools.

SKILLS

- Have a wide-field perspective on computational neuroscience, machine learning.
- Fluent with advanced mean-field methods from statistical physics (replica and cavity methods, message passing, kernel methods, KKT, RMT).
- Superb software engineering skills (fluent coding at C/C++/Python/MATLAB).
- Passion for teaching, extensive experience.
- Experience in numerical methods, deep learning tools, and large-scale simulations.
- Experience in neural data analysis; e.g., Freiwald & Tsao 2010, Majaj, Hong, et al. 2015, Stringer, Pachitariu, et al. 2019.
- A team player and good at collaboration.
- Thorough, down-to-details approach.
- Welcomes feedback and criticism.

PUBLICATIONS

- **Cohen, U.**, Rodriguez, R. M., Paulsen, O., & Lengyel, M. (2024). *A theory of memory stability in hippocampal area CA3*. COSYNE 2024 (submitted).
- **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