Mozes Jacobs

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Education

Harvard University — Cambridge, MA
Ph.D. in Computer Science | Advisor: Demba Ba | Kempner Graduate Fellow — *2023 – 2028 (Expected)*

University of Washington — Seattle, WA
B.S. in Computer Science | Advisor: Rajesh Rao | GPA: 3.99 / 4.00 — *2018 – 2022*

Publications & Preprints

[1] **Jacobs M.***, Fel T.*, Hakim R.*, Brondetta A., Ba D., Keller TA. (2025). **Block-Recurrent Dynamics in ViTs**. *International Conference on Learning Representations (ICLR) 2026 (accepted).*

[2] **Jacobs M.**, Budzinski RC., Muller L., Ba D., Keller TA. (2025). **Traveling Waves Integrate Spatial Information Through Time**. *Cognitive Computational Neuroscience (CCN) 2025 (oral).*

[3] **Jacobs M.**, Budzinski RC., Muller L., Ba D., Keller TA. (2025). **Traveling Waves Integrate Spatial Information Intro Spectral Representations**. *International Conference on Learning Representations (ICLR) 2025 Re-Align Workshop.*

[4] **Jacobs M.**, Brunton BW., Brunton SL., Kutz JN., Raut RV. (2023). **HyperSINDY: Deep Generative Modeling of Nonlinear Stochastic Governing Equations**. *Preprint.*

Professional Experience

Kempner Institute (Harvard University) — Cambridge, MA
Graduate Research Fellow | Advisor: Demba Ba — *2023 – Present*

- **Block-Recurrent Foundation Models (Raptor):** Developed the *Block-Recurrent Hypothesis*, demonstrating that foundation models (e.g., DINOv2) can be accurately distilled using recurrent blocks. Trained surrogate models to recover **96%** of ImageNet-1k accuracy using only **2 distinct blocks** applied recurrently (vs. original depth), offering a normative solution for model compression.
- **Dynamical Interpretability:** Established a mechanistic framework characterizing ViT depth as a flow into low-dimensional attractors. Uncovered token-specific dynamics, including self-correcting trajectories and low-rank updates in late layers, bridging the gap between deep learning and dynamical systems analysis.
- **Neuro-Inspired Architectures:** Designed convolutional recurrent models that utilize traveling waves for global spatial information integration, outperforming standard U-Nets on semantic segmentation benchmarks.

Allen Institute (AI Institute in Dynamic Systems) — Seattle, WA
Shanahan Foundation Predoctoral Fellow | Advisors: Ryan Raut, J. Nathan Kutz, Steve Brunton — *2022 – 2023*

- **HyperSINDy:** Developed a probabilistic framework for modeling stochastic dynamics via deep generative models and amortized variational inference, enabling uncertainty quantification for sparse governing equations.

Neural Systems Lab (University of Washington) — Seattle, WA
Undergraduate Research Assistant | Advisor: Rajesh Rao — *2019 – 2022*

- **Predictive Coding:** Proposed *Gradient Origin Predictive Coding*, a novel video generation framework merging cortical theories of predictive coding with Bayesian deep learning for next-frame prediction.

Noble Lab (University of Washington) — Seattle, WA
Undergraduate Research Assistant | Advisor: Bill Noble — *2020 – 2022*

- **Genomic Algorithms:** Optimized *PASTIS*, a Poisson-based algorithm for inferring 3D chromatin structures from Hi-C maps, significantly reducing memory overhead and workflow runtime.

Invited Talks

[1] **Traveling Waves Integrate Spatial Information Through Time**. Neural Computations: Dynamics Across Space, Time, and Task - *CCN*. (August 2025).

[2] **Can Your Neurons Hear the Shape of an Object?** Frontiers in NeuroAI Symposium - Kempner Institute. (June 2025).

Awards & Fellowships

Kempner Institute Graduate Fellowship | Harvard University — 2023 – Present
Shanahan Foundation Predoctoral Fellowship | Allen Institute — 2022
Burkhardt Family Endowed Scholarship — 2020, 2021
Gary A. Kildall Endowed Scholarship — 2019
Boeing Scholarship — 2018

Technical Skills

Languages & Frameworks: Python, PyTorch
Research Areas: Computer Vision, Visual Representation Learning, Mechanistic Interpretability, Foundation Models