Surya Ganguli

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Department of Applied Physics,
Stanford University
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Education

University of California Berkeley — Berkeley, CA
Ph.D. Theoretical Physics, October 2004.
Thesis: "Geometry from Algebra: The Holographic Emergence of Spacetime in String Theory"
M.A. Mathematics, June 2004.
M.A. Physics, December 2000.

Massachusetts Institute of Technology — Cambridge, MA
M.Eng. Electrical Engineering and Computer Science, May 1998.
B.S. Physics, May 1998.
B.S. Mathematics, May 1998.
B.S. Electrical Engineering and Computer Science, May 1998.

University High School — Irvine, CA
Graduated first in a class of 470 students at age 16, May 1993.

Research Positions

Stanford University — Stanford, CA
Department of Applied Physics, and by courtesy, — *Jan 12 to present*
Department of Neurobiology
Department of Computer Science
Department of Electrical Engineering
Associate Professor with tenure, Jan 2020-present
Assistant Professor, Jan 2012-Dec 2019

Facebook — Menlo Park, CA
Facebook Artificial Intelligence Research — *Jun 20 to present*
Research Scientist

Google — Mountain View, CA
Google Brain Deep Learning Team — *Feb 17 to Mar 20*
Visiting Research Professor, 1 day a week.

University of California, San Francisco — San Francisco, CA
Sloan-Swartz Center for Theoretical Neurobiology — *Sept 04 to Jan 12*
Postdoctoral Fellow. Conducted theoretical neuroscience research.

Awards

NeurIPS 2022 Outstanding paper award
NSF Career Award 2019-2024
Simons Investigator Award in MMLS 2016-2021 (awarded to 4 scientists in the nation)
McKnight Scholar Award, 2015-2018 (awarded to 6 neuroscientists in the nation)
James S. McDonnell Foundation Scholar Award in Human Cognition, 2014-2020
(awarded to 8 scientists across the world)
Cosyne 2014, Number 1 Ranked abstract, out of 550.
NIPS 2014 Outstanding paper award (awarded to 3 papers out of 1420 submissions)
Alfred P. Sloan Foundation Fellowship, 2013-2015 (awarded to 20 neuroscientists in the nation)
Terman Award, 2012-2015
Burroughs Wellcome Career Award at the Scientific Interface, 2009-2014
(awarded to 6 postdoctoral fellows in the nation)
Sloan-Swartz Fellowship, 2004-2009
Berkeley Outstanding Graduate Instructor
Tau Beta Pi

Phi Beta Kappa

Pubs in review

S. Fort, E.D. Cubuk, S.Ganguli, S.S. Schoenholz, What does a deep neural network confidently perceive? The effective dimension of high certainty class manifolds and their low confidence boundaries, arXiv preprint arXiv:2210.05546.

D. Kunin, A. Yamamura, C. Ma, S. Ganguli. The Asymmetric Maximum Margin Bias of Quasi-Homogeneous Neural Networks, arXiv preprint arXiv:2210.03820.

J.C.R. Whittington, W. Dorrell, S. Ganguli, T.E.J. Behrens, Disentangling with Biological Constraints: A Theory of Functional Cell Types, arXiv:2210.01768.

M. Paul, F. Chen, BW. Larsen, J. Frankle, S. Ganguli, G.K. Dziugaite, Unmasking the Lottery Ticket Hypothesis: What's Encoded in a Winning Ticket's Mask, arXiv preprint arXiv:2210.03044.

JM Sorokin, AH Williams, S Ganguli, JR Huguenard, Thalamic activity patterns unfolding over multiple time scales predict seizure onset in absence epilepsy, www.biorxiv.org/content/10.1101/2020.03.04.976688v1.

SE Harvey, S Lahiri, S Ganguli, A universal energy accuracy tradeoff in nonequilibrium cellular sensing arXiv preprint arXiv:2002.10567.

S. Fort and S. Ganguli, Emergent properties of the local geometry of neural loss landscapes, https://arxiv.org/abs/1910.05929

L. McIntosh, N. Maheswaranathan, S. Ganguli, S. Baccus, Deep learning models reveal internal structure and diverse computations in the retina under natural scenes, www.biorxiv.org/content/early/2018/06/08/340943.

S. Lahiri, S. Sohl-Dickstein and S. Ganguli, A universal tradeoff between energy speed and accuracy in physical communication, https://arxiv.org/abs/1603.07758.

P. Gao, E. Trautmann, B. Yu, G. Santhanam, S. Ryu, K. Shenoy and S. Ganguli, A theory of neural dimensionality, dynamics and measurement, https://www.biorxiv.org/content/early/2017/11/05/214262.

S. Lahiri, P. Gao, and S. Ganguli, Random projections of random manifolds, https://arxiv.org/abs/1607.04331.

Publications

B. Sorscher, S. Ganguli, H. Sompolinsky, The Geometry of Concept Learning, in press at PNAS.

B. Sorscher, G.C. Mel, S.A. Ocko, L. Giocomo, S. Ganguli, A unified theory for the computational and mechanistic origins of grid cells, in press at Neuron.
bioarxiv version: https://www.biorxiv.org/content/10.1101/2020.12.29.424583v1

J. Timcheck, J. Kadmon, K. Boahen, S. Ganguli, Optimal noise level for coding with tightly balanced networks of spiking neurons in the presence of transmission delays, in press at PLOS Computational Biology.

M Paul, BW Larsen, S Ganguli, J Frankle, GK Dziugaite, Lottery Tickets on a Data Diet: Finding Initializations with Sparse Trainable Networks, Neural Information Processing Systems (NeurIPS) 2022.

Sorscher, Ben, Robert Geirhos, Shashank Shekhar, Surya Ganguli, and Ari S. Morcos, Beyond Neural Scaling Laws: Beating Power Law Scaling via Data Pruning, Neural Information Processing Systems (NeurIPS) 2022.

CH Stock, SE Harvey, SA Ocko, S Ganguli, Synaptic balancing: a biologically plausible local learning rule that provably increases neural network noise robustness without sacrificing task performance, Neural Computation, 2022.

Hazon, Omer, Victor H. Minces, David P. Toms, Surya Ganguli, Mark J. Schnitzer, and Pablo E. Jercog. Noise Correlations in Neural Ensemble Activity Limit the Accuracy of Hippocampal Spatial Representations. Nature Communications 13 (1): 4276, 2022.

A. Nayebi, J. Sagastuy-Brena, D.M. Bear, K. Kar, J. Kubilius, S. Ganguli, D. Sussillo, J.J. DiCarlo, D.L.K Yamins, Recurrent Connections in the Primate Ventral Visual Stream Mediate a Tradeoff Between Task Performance and Network Size During Core Object Recognition, Neural Computation, 2022.

A. Gupta, L. Fan, S. Ganguli, and Li Fei-Fei, MetaMorph: Learning Universal Controllers with Transformers, International Conference on Learning Neural Representations (ICLR), 2022.

BW Larsen, S Fort, N Becker, S Ganguli, How many degrees of freedom do we need to train deep networks: a loss landscape perspective, International Conference on Learning Neural Representations (ICLR), 2022.

Ebrahimi S, Lecoq J, Rumyantsev O, Tasci T, Zhang Y, Irimia C, Li J, Ganguli S, Schnitzer MJ. Emergent reliability in sensory cortical coding and inter-area communication. Nature. 2022 May;605(7911):713-721.

M. Paul, S. Ganguli, G.K. Dziugaite, Deep Learning on a Data Diet: Finding Important Examples Early in Training, NeurIPS 2021.

A. Nayebi, A. Attinger, M. Campbell K. Hardcastle , I. Low, C.S. Mallory, Gabriel Mel, B. Sorscher, A.H Williams , S. Ganguli, L. Giocomo, D. Yamins, Explaining heterogeneity in medial entorhinal cortex with task-driven neural networks, NeurIPS 2021.

A Gupta, S Savarese, S Ganguli, L Fei-Fei, Embodied Intelligence via Learning and Evolution, Nature Communications 2021.

J.B. Melander, A. Nayebi, B.C Jongbloets, D.A. Fortin, M. Qin, S. Ganguli, T. Mao, H. Zhong, Distinct in vivo dynamics of excitatory synapses onto cortical pyramidal neurons and parvalbumin-positive interneurons, Cell Reports 2021.

MG Campbell, A Attinger, SA Ocko, S Ganguli, LM Giocomo, Distance-tuned neurons drive specialized path integration calculations in medial entorhinal cortex, Cell reports, 2021.

G. Mel and S. Ganguli, A theory of high dimensional regression with arbitrary correlations between input features and target functions: sample complexity, multiple descent curves and a hierarchy of phase transitions, ICML 2021.

Y. Tian, X. Chen and S. Ganguli, Understanding self-supervised learning dynamics without contrastive pairs, ICML 2021, Best Paper Award, honorable mention.

MJ. Wagner, J. Savall, O. Hernandez, G. Mel, H. Inan, O. Rumyantsev, J. Lecoq, TH. Kim, JZ. Li, C. Ramakrishnan, K. Deisseroth, L. Luo, S. Ganguli, and MJ Schnitzer, A neural circuit state change underlying skilled movements, Cell, 2021.

B.P. Marsh, Y. Guo, R.M. Kroeze, S. Gopalakrishnan, S. Ganguli, J. Keeling, and BL. Lev, Enhancing associative memory recall and storage capacity using confocal cavity QED, Physical Review X 2021.

K. Mann, S Deny, S Ganguli, and TR Clandinin, Coupling between neural activity, metabolism, and behavior across the Drosophila brain, Nature 2021.

D. Kunin, J. Sagastuy-Brena, S. Ganguli, D. LK Yamins, H. Tanaka, Neural Mechanics: Symmetry and Broken Conservation Laws in Deep Learning Dynamics, ICLR 2021.

YH. Takeo, SA. Shuster, L. Jiang, M. Hu, DJ. Luginbuhl, T. Rlicke, X. Contreras, S. Hippenmeyer, MJ. Wagner, S. Ganguli, L. Luo, GluD2- and Cbln1-mediated Competitive Synaptogenesis Shapes the Dendritic Arbors of Cerebellar Purkinje Cells, Neuron 2020.

A. Nayebi, S. Srivastava, S. Ganguli, D. Yamins, Identifying learning rules from neural network observables, NeurIPS 2020.

J. Kadmon, J. Timcheck, and S. Ganguli, Predictive coding in balanced neural networks with noise, chaos and delays, NeurIPS 2020.

S. Fort, G.K. Dziugaite, M. Paul, D. Roy, S. Ganguli, Deep learning versus kernel learning: an

empirical study of loss landscape geometry and the time evolution of the neural tangent Kernel, NeurIPS, 2020.

H. Tanaka, D. Kunin, DLK. Yamins, S. Ganguli, Pruning neural networks without any data by iteratively conserving synaptic flow, NeurIPS 2020.

Y Yamamoto, T Leleu, S Ganguli, H Mabuchi, Coherent Ising machines: quantum optics and neural network perspectives, Applied Physics Letters, 2020.

J Hewitt, M Hahn, S Ganguli, P Liang, CD Manning, RNNs can generate bounded hierarchical languages with optimal memory, EMNLP 2020.

D Kunin, A Nayebi, J Sagastuy-Brena, S Ganguli, J Bloom, DLK Yamins, Two Routes to Scalable Credit Assignment without Weight Symmetry, International Conference on Machine Learning, ICML 2020.

O.I. Rumyantsev, J.A. Lecoq, J.C. Savall, H. Zeng, S. Ganguli, M.J. Schnitzer, Fundamental limits of information encoding by sensory cortical neural ensembles, Nature 2020.

Y. Bahri, J. Kadmon, J. Pennington, S. Schoenholz, J. Sohl-Dickstein, and S. Ganguli, Statistical mechanics of deep learning, Annual Reviews of Condensed Matter Physics, 2020.

A. Williams,, B. Poole, N. Maheswaranathan, A. Dhawale, T. Fisher, C. Wilson, D. Brann, E. Trautmann, S. Ryu, R. Shusterman, D. Rinberg, B. lveczky, K. Shenoy, S. Ganguli, Discovering precise temporal patterns in large-scale neural recordings through robust and interpretable time warping, Neuron, 2019.

H. Tanaka, A. Nayebi, N. Maheswaranathan, L.M. McIntosh, S. Baccus, S. Ganguli, From deep learning to mechanistic understanding in neuroscience: the structure of retinal prediction, NeurIPS 2019.

B. Sorscher, G. Mel, S. Ganguli, S. Ocko, A unified theory for the origin of grid cells through the lens of pattern formation, NeurIPS 2019.

N. Maheswaranathan, A. Williams, M. Golub, S. Ganguli, and D. Sussillo, Universality and individuality in neural dynamics across large populations of recurrent networks, NeurIPS 2019.

N. Maheswaranathan, A. Williams, M. Golub, S. Ganguli, and D. Sussillo, Reverse engineering recurrent networks for sentiment classification reveals line attractor dynamics, NeurIPS 2019.

J.H. Marshel, Y. S. Kim, T.A. Machado, S. Quirin, B. Benson, J. Kadmon, C. Raja, A. Chibukhchyan, C. Ramakrishnan, M. Inoue, J.C. Shane, D.J. McKnight, S. Yoshizawa, H.E. Kato, S. Ganguli, K. Deisseroth, Cortical layer-specific critical dynamics triggering perception, Science 2019.

E.M. Trautmann, S. Lahiri, S.D. Stavisky, K.C. Ames, M.T. Kaufman, S.I. Ryu, S. Ganguli, and K.V. Shenoy, Accurate estimation of neural population dynamics without spike sorting, Neuron, 2019.

A. Saxe, J. McClelland, and S. Ganguli, A mathematical theory of semantic development, PNAS, 2019.

M.J. Wagner, T.H Kim, J. Kadmon, N.D. Nguyen, S. Ganguli, M.J. Schnitzer, L. Luo, Shared cortex-cerebellum dynamics in the execution and learning of a motor task, Cell, 2019.

S. Ocko, J. Lindsey, S. Ganguli, and S. Deny, The effects of neural resource constraints on early visual representations, International Conference on Learning Representations (ICLR), 2019.

A.K. Lampinen and S. Ganguli, An analytic theory of generalization dynamics and transfer learning in deep linear networks, International Conference on Learning Representations (ICLR), 2019.

S. Ocko, K. Hardcastle, L. Giocomo and S. Ganguli, Emergent elasticity in the neural code for space, PNAS, 2018.

J. Kadmon and S. Ganguli, Statistical mechanics of low-rank tensor decomposition, Neural Information Processing Systems (NeurIPS) 2018.

S. Deny, J. Lindsey, S. Ganguli, S. Ocko, The emergence of multiple retinal cell types through efficient coding of natural movies, Neural Information Processing Systems (NeurIPS) 2018.

A. Nayebi, D. Bear, J. Kubilius, K. Kar, S. Ganguli, J.J. DiCarlo, D. Sussillo, D.L.K. Yamins, Task-Driven Convolutional Recurrent Models of the Visual System, Neural Information Processing Systems (NeurIPS) 2018.

N. Maheswaranathan, S. Baccus, S. Ganguli, Inferring hidden structure in multilayered neural circuits, PLOS Computational Biology, 2018.

M.G. Campbell, S.Ocko, C.S. Mallory, S. Ganguli, L.M. Giocomo, Principles governing the integration of landmark and self-motion cues in entorhinal cortical codes for navigation, Nature Neuroscience, 2018.

A.H. Williams, T.H. Kim, F. Wang, S. Vyas, S.I. Ryu, K.V. Shenoy, M.J Schnitzer, T.G. Kolda, and S. Ganguli, Unsupervised discovery of demixed, low-dimensional neural dynamics across multiple timescales through tensor components analysis, Neuron 2018.

F. Zenke and S. Ganguli, SuperSpike: Supervised learning in multi-layer spiking neural networks, Neural Computation 2018 Jun 30(6):1514-1541.

J. Pennington, S. Schloenholz, and S. Ganguli, The emergence of spectral universality in deep networks, Artificial Intelligence and Statistics (AISTATS) 2018.

The International Brain Lab (IBL) Consortium, An International Laboratory for Systems and Computational Neuroscience, Neuron (2017).

K. Hardcastle, S. Ganguli, and L. Giocomo, Cell-types for our sense of location: where we are and where we are going, Nature Neuroscience (2017) 20:1474-82.

J. Pennington, S. Schloenholz, and S. Ganguli, Resurrecting the sigmoid in deep learning through dynamical isometry: theory and practice, Neural Information Processing Systems (NIPS) 2017.

R. Ke, A. Goyal, S. Ganguli and Y. Bengio, Variational Walkback: Learning a Transition Operator as a Stochastic Recurrent Net, Neural Information Processing Systems (NIPS) 2017.

T. Yang, C.F. Yang, M.D. Chizari, N. Maheswaranathan, K. Burke, Jr., M. Borius, S. Inoue, M.C. Chiang, K.J. Bender, S.Ganguli, and N. Shah, Social control of hypothalamus-mediated male aggression, Neuron (2017) 95(4):955?970.

F. Zenke, B. Poole and S. Ganguli, Continual Learning with Intelligent Synapses, International Conference on Machine Learning (ICML) 2017.

M. Raghu, B. Poole, J. Kleinberg, S. Ganguli, and J. Sohl-Dickstein, On the expressive power of deep neural networks, International Conference on Machine Learning (ICML) 2017.

K. Hardcastle, N. Maheswaranathan, S. Ganguli, L. Giocomo, A multiplexed, heterogeneous, and adaptive code for navigation in medial entorhinal cortex, Neuron (2017) 94(2):375-87.

S. Schoenholz, J. Gilmer, S. Ganguli, and J. Sohl-Dickstein, Deep information propagation, International Conference on Learning Representations (ICLR) 2017.

F. Zenke, W. Gertsner, S. Ganguli, The temporal paradox of Hebbian learning and homeostatic plasticity, Current Opinion in Neurobiology (2017) 43:166-76.

T.D. Vu, G.Q. Zhao, S. Lahiri, A. Suvrathan, H. Lee, S. Ganguli, C.J. Shatz, J.L. Raymond, A saturation hypothesis to explain both enhanced and impaired learning with enhanced plasticity, eLife 2017;6:e20147

L. McIntosh, N. Maheswaranathan, S. Ganguli, S. Baccus, Deep learning models of the retinal response to natural scenes, Neural Information Processing Systems (NIPS) 2016.

B. Poole, S. Lahiri, M. Raghu, J. Sohl-Dickstein, and S. Ganguli, Exponential expressivity in deep neural networks through transient chaos, Neural Information Processing Systems (NIPS) 2016.

M. Advani and S. Ganguli, An equivalence between high dimensional Bayes optimal inference and M-estimation, Neural Information Processing Systems (NIPS) 2016.

M. Advani and S. Ganguli, Statistical mechanics of optimal convex inference in high dimensions, Physical Review X, 6, 031034, 2016.

J. Leong, J. Esch, B. Poole, S. Ganguli, T. Clandinin, Direction selectivity in Drosophila emerges from preferred-direction enhancement and null-direction suppression, Journal of Neuroscience (2016) 36(31): 8078-8092.

C. Piech, J. Spencer, J. Huang, S. Ganguli, M. Sahami, L. Guibas, J, Sohl-Dickstein, Deep knowledge tracing, Neural Information Processing Systems (NIPS) 2015.

K. Bouchard, S. Ganguli, and M. Brainard, Role of the site of synaptic competition and the balance of learning forces for Hebbian encoding of probabilistic Markov sequences (2015), Frontiers in Computational Neuroscience.

J. Sohl-Dickstein, N. Maheswaranathan, E. Weiss, S. Ganguli, Deep unsupervised learning using non-equilibrium thermodynamics, International Conference on Machine Learning (ICML) 2015.

P. Gao and S. Ganguli, On simplicity and complexity in the brave new world of large-scale neuroscience, Current Opinion in Neurobiology (2015) 32:148-55.

K. Hardcastle, S. Ganguli, L. Giocomo, Environmental boundaries as an error correction mechanism for grid cells, Neuron, (2015) 86(3):827-39.

Y. Dauphin, R. Pascanu, C. Gulcehre, K. Cho, S. Ganguli, Y. Bengio, Identifying and attacking the saddle point problem in high-dimensional non-convex optimization, Neural Information Processing Systems, 2014.

J. Sohl-Dickstein, B. Poole, and S. Ganguli, Fast large scale optimization by unifying stochastic gradient and quasi-Newton methods, International Conference on Machine Learning (ICML), 2014.

A. Saxe, J. McClelland, S. Ganguli, Exact solutions to the nonlinear dynamics of learning in deep neural networks, International Conference on Learning Representations (ICLR) 2014.

N. Giret, J. Kornfeld, S. Ganguli, R. Hahnloser. Evidence for a causal inverse model in an avian cortico-basal ganglia circuit, PNAS, 2014

B. Poole, J. Sohl-Dickstein, and S. Ganguli, Analyzing noise in auto-encoders and deep networks, Neural Information Processing Systems Workshop on Deep Learning, 2013.

S. Lahiri, and S. Ganguli, A memory frontier for complex synapses, Neural Information Processing Systems (NIPS), 2014. (*Winner of the NIPS 2013 Outstanding paper award, given to 3 papers out of 1420 submissions.)

A. Saxe, J. McClelland, S. Ganguli, Learning hierarchical category structure in deep neural networks, In M. Knauff, M. Paulen, N. Sebanz, and I. Wachsmuth (Eds.), Proc. of the 35th annual meeting of the Cognitive Science Society, pp. 1271-1276, 2013.

J. Kao, P. Nuyujukian, S. Stavisky, S. Ryu, S. Ganguli, K.V. Shenoy, Investigating the role of firing-rate normalization and dimensionality reduction on brain-machine interface robustness. Proc. of the 35th Annual International Conference IEEE EMBS. Osaka, Japan: 293-298.

A. Hanuschkin, S. Ganguli, R.H.R. Hahnloser, A Hebbian learning rule gives rise to mirror neurons and links them to control theoretic inverse models, Frontiers in Neural Circuits (2013), 7, 00106.

M. Advani, S. Lahiri and S. Ganguli, Statistical mechanics of complex neural systems and high dimensional data, Journal of Statistical Mechanics Theory and Experiment (2013), P03014.

R. Hahnloser and S. Ganguli, Vocal learning with inverse models, book chapter in *Principles of Neural Coding*, (2013) CRC press.

S. Kim*, S. Ganguli* and L. Frank, Spatial Information Outflow from the Hippocampal Circuit: Distributed Spatial Coding and Phase Precession in the Subiculum, Journal of Neuroscience (2012) 32(34):11539 58. (*equal author)

S. Ganguli and H. Sompolinsky, Compressed sensing, sparsity and dimensionality in neuronal information processing and data analysis, Ann. Rev. of Neuroscience, (2012) 35:485508

S. Ganguli and H. Sompolinsky, Short-term memory in neuronal networks through dynamical compressed sensing, Neural Information Processing Systems (2010).

S. Ganguli and H. Sompolinsky, Statistical Mechanics of Compressed Sensing, Phys. Rev. Lett. (2010) 104:188701.

S. Ganguli and P. Latham, Feedforward to the past: the relation between neuronal connectivity, amplification, and short-term memory, Neuron (2009) 61:499-501. (Preview)

S. Ganguli, B. Huh, H. Sompolinsky, Memory Traces in Dynamical Systems, PNAS (2008) 105:18970-75.

S. Ganguli, J. Bisley, J. Roitman, M. Shadlen, M. Goldberg and K. Miller, One Dimensional Dynamics of Attention and Decision Making in LIP, Neuron (2008) 58:15-25.

K. Lau, S. Ganguli and C. Tang, Function Constrains Network Architecture and Dynamics: A Case Study on the Yeast Cell Cycle Network, Phys. Rev. E75 (2007) 051907. (arxiv.org/abs/q-bio/0610025).

S. Ganguli, A. Ndirango and P. Horava, Boundary Scattering in 1+1 Dimensions as an Aharanov-Bohm Effect, (arxiv.org/abs/hep-th/0501233).

J. Brown, S. Ganguli, O. Ganor, C. Helfgott, E10 Orbifolds, JHEP 06 (2005) 057, (arxiv.org/abs/hep-th/0409037).

S. Ganguli, O. Ganor and J. Gill, Twisted Six Dimensional Gauge Theories, Matrix Models and Integrable Systems, JHEP 0409 (2004) 014, (arxiv.org/abs/hep-th/0311042).

E.K. Boyda, S. Ganguli, P. Horava and U. Varadarajan, Holographic Protection of Chronology in Universes of the G odel Type, Phys. Rev. D67 (2003) 106003, (hep-th/0212087).

Talks

2022 Oct NIH Systems Neuroscience Seminar Series, Bethesda, MD.
2022 Oct Berkeley Physics Colloquium, Berkeley, CA.
2022 Oct Coherent Network Computing Conference, Stanford, CA.
2022 Oct Center for Intelligent Systems Colloquium, EPFL, Lausanne, Switzerland.
2022 Sep Center for Mathematical Sciences and Applications, Harvard, Cambridge, MA.
2022 Sep Simons Workshop on New Horizons in Artificial Intelligence, Schloss Elmau, Germany.
2022 Aug Lecturer, Methods in Computational Neuroscience, Woods Hole, MA.
2022 Jul Sparsity in neural networks workshop, ICML.
2022 Mar NSF Frontiers in Emerging Technologies workshop on Ising Machines.
2022 Mar Neural Circuits Meeting, Cold Spring Harbor Labs, NY.
2022 Mar Physics of Learning, March APS Meeting, Chicago, IL.
2022 Feb Loss Landscapes of Neural Networks, EPFL, Lausanne, Switzerland.
2022 Feb AI and the Brain Seminar, Carnegie Mellon University, Pittsburgh, PA.
2021 Dec Neurips Workshop, Machine learning and the physical science, Vancouver, Canada.
2021 Nov Montreal AI and Neuroscience Annual Meeting, Montreal, CA.
2021 Oct NIMH Fellows Invited Lecture Series, National Institutes of Health, MD.
2021 Oct Stanford Physics Colloquium, Stanford, CA.
2021 Sep Neuroscience Seminar, University of Chicago, IL.

2021 Sep NTT Research Summit, Sunnyvale, CA.
2021 Sep NSF Artificial Intelligence and Fundamental Interactions Colloquium, MIT, MA.
2021 Aug Distinguished Speaker, NIH Brain Initiative Annual Neuroscience Virtual Conference.
2021 Aug Neuromatch Deep Learning Summer School (Virtual)
2021 Aug Lecturer, Methods in Computational Neuroscience, Woods Hole, MA.
2021 Jun Beg Rou Summer School of Statistical Physics and Condensed Matter, France.
2021 Jun Neurocolloquium, Tuebingen, Germany.
2021 May AI Seminar, University of Southern California, CA.
2021 Apr Machine Learning Seminar, Vector Institute, Toronto, Canada.
2021 Mar Neuroscience Graduate Program Seminar, Brown University, RI.
2021 Mar Machine Learning Theory Seminar, Harvard University, MA.
2021 Mar AAAI Symposium, Combining AI with the Physical Sciences, Stanford, CA.
2021 Jan Mathematical Institute for Data Science Seminar, Johns Hopkins, MD.
2021 Jan Distinguished Seminar Series, Allen Institute, Seattle, WA.
2020 Dec Language Learning Networks Symposium, CUNY Center for Theoretical Sciences, NY.
2020 Nov Department of Psychiatry Seminar, Yale University, CT.
2020 Nov Colloquium, Center of Mathematical Sciences and Applications, Harvard, MA.
2020 Nov From neuroscience to artificially intelligent systems, Cold Spring Harbor, NY.
2020 Apr Allen Institute Workshop, Seattle, WA.
2020 Apr Princeton Center for Theoretical Physics, Princeton, NJ.
2020 Apr Weinberg Symposium on Cognitive Science of Concepts, University of Michigan, MI.
2020 Mar APS symposium: Statistical physics meets machine learning, Denver, CO.
2020 Mar Cosyne Workshop, 15 years of grid cells, Denver, CO.
2020 Feb Information Theory and its Applications Workshop, San Diego, CA.
2020 Jan Simons Center for Geometry and Physics, Stony Brook, NY.
2019 Dec NeurIPS Workshop, Science meets engineering in deep learning, Vancouver, Canada.
2019 Dec NeurIPS Workshop Real neurons and hidden units, Vancouver, Canada.
2019 Nov Computational Neuroscience Seminar, University of Pennsylvania, PA.
2019 Oct Conference on Mathematical Theory of Deep Neural Networks, Princeton Club, NY.
2019 Oct Theory of Deep Neural Networks, Institute for Advanced Study, NJ.
2019 Sep Workshop on 40 years of replica symmetry breaking, Rome, Italy.
2019 Aug Lecturer, Methods in Computational Neuroscience, Woods Hole, MA.
2019 Jul Mind matters: Intelligence and agency in the physical world, Tuscany, Italy.
2019 Jul EPFL Symposium, Neuroscience meets deep learning, Lausanne, Switzerland.
2019 May Neuroscience Department Seminar, Washington University, St. Louis, MO.
2019 May Inaugural Symposium of the Zuckerman Institute, Columbia University, NY.
2019 Apr Joint Seminar in Neuroscience, UCLA, CA.
2019 Apr Biomedical engineering seminar, Northwestern University, IL.
2019 Mar Mechanisms of Learning Forum, Emory University, Atlanta, GA.
2019 Mar Emory and Georgia Tech Joint Kavli Brain Forum, Atlanta, GA.
2019 Mar Neuro-inspired Computing Course, Toyko University, Japan.
2019 Feb Neurobiology Seminar, Duke University, NC.
2019 Feb Annual Gulf Coast Theoretical and Computational Neuroscience Symposium, Houston.
2019 Jan Deep Learning and the Brain Symposium, Hebrew University, Jerusalem, Israel.
2019 Jan Kavli Institute for Theoretical Physics, Santa Barbara, CA.
2018 Nov Colloquium, Center for the Neural Basis for Cognition, Carnegie Mellon, PA.
2018 Nov Colloquium, Renaissance Technologies, NY.
2018 Nov Computational and Systems Neuroscience Seminar, Caltech, CA.
2018 Oct Research Symposium, Champalimaud Center for the Unknown, Lisbon, Portugal.
2018 Oct Stanford Neuroscience Institute Symposium, Stanford, CA.
2018 Oct NIH Brain Initiative Workshop, Houston, TX.

2018 Sep Parallel Distributed Processing and the Emergence of Mind, Princeton, NJ.
2018 Sep Bernstein Conference, Berlin, Germany.
2018 Aug Statistical physics and machine learning back together, Cargese, France.
2018 Aug Lecturer, Methods in Computational Neuroscience, Woods Hole, MA.
2018 Jul International Congress of Mathematical Physics, Montreal, Canada.
2018 Jul Tsinghua University, Beijing, China.
2018 Jul Center for Quantitative Biology, Peking University, Beijing, China.
2018 Jun Keynote Speaker, CRCNS PI Meeting, Berkeley, CA.
2018 Jun McKnight Neuroscience Conference, Aspen, CO.
2018 Jun Bridging Scales in Neuroscience, Max Planck Society Conference, Bonn, Germany.
2018 May Computer Systems Colloquium, Stanford University, CA.
2018 Apr MIT AI Conference, San Francisco, CA.
2018 Apr Workshop on Computational Theories of the Brain, Berkeley, CA.
2018 Apr Simons Foundation Theory in Biology Workshop, New York, NY.
2018 Mar Distributed Computation in Biological and Artificial Systems, Janelia Farm.
2018 Jan Re-Work Deep Learning Summit, San Francisco, CA.
2018 Jan Physics informed machine learning workshop, Santa Fe, NM.
2018 Jan Keystone Symposium on the State of the Brain, Keystone, CO.
2018 Jan 10th Year Symposium, Tata Institute for Fundamental Research, Bangalore, India.
2017 Dec International Centre for Theoretical Sciences, Workshop, Bangalore, India.
2017 Dec CIFAR Learning in Brains and Machines program meeting, Long Beach, CA.
2017 Nov Neuroscience Colloquium, Columbia University, New York, NY.
2017 Nov Neuroscience Colloquium, Princeton Neuroscience Institute, Princeton, NJ.
2017 Oct Symposium, Bernstein Center for Computational Neuroscience, Berlin, Germany.
2017 Sep Workshop: From Synaptic Plasticity to Motor Control, EPFL, Lausanne, Switzerland.
2017 Aug Principled Approaches to Deep Learning, ICML Workshop, Sydney, Australia.
2017 Aug Lecturer, Methods in Computational Neuroscience, Woods Hole, MA.
2017 Jul Condensed Matter School on Frustrated and Disordered Systems, Boulder, Colorado.
2017 Jul Computational and Cognitive Neuroscience Summer School, Shanghai, China.
2017 Jun CIFAR Deep Learning Summer School, Montreal.
2017 May Neural Control of Movement Conference, Dublin, Ireland.
2017 Mar The Future of Artificial Intelligence, MIT Tech Conference.
2017 Mar Association for the Advancement of Artificial Intelligence (AAAI) Symposium.
2017 Mar Applied Mathematics Seminar, Harvard.
2017 Feb Les-Houches School on Statistical physics, learning, inference and networks, France.
2017 Feb Invited Speaker, Computational and Systems Neuroscience Conference, Salt Lake City.
2017 Jan IBRO-Simons Computational Neuroscience Imbizo, Cape Town, South Africa.
2017 Jan Statistical mechanics meeting, Berkeley.
2017 Jan Exploring the interface of statistical mechanics and machine learning, Berkeley.
2017 Jan Google Brain Research Seminar, Mountain View, CA.
2016 Dec Advances in Approximate Bayesian Inference, NIPS Workshop, Barcelona.
2016 Dec Workshop on Non-convex Optimization for Machine Learning, NIPS Workshop, Barcelona.
2016 Dec Statistical Neural Data Analysis, NIPS Workshop, Barcelona.
2016 Dec CIFAR Deep Learning Workshop, Barcelona.
2016 Nov Stanford Institute for Theoretical Physics, Colloquium, Stanford.
2016 Nov Theory of Computation, Associated Meeting, Stanford.
2016 Oct Computational Neuroscience Talk, UCSD.
2016 Oct Neuroscience Colloquium, UCSD.
2016 Oct CodeNeuro Conference on Neuroscience and Data Science, San Francisco, CA.
2016 Sep NSF/Kavli Meeting: Coordinating Global Brain Projects, Rockefeller, NY.
2016 Sep Group for Neural Theory, Ecole Normale Superieure, Paris.

2016 Aug Lecturer, Methods for Computational Neuroscience, Woods Hole, MA.
2016 Aug CIFAR Deep Learning Summer School, Montreal.
2016 Aug Swartz Meeting in Computational Neuroscience, Caltech
2016 Jul School on Mining and Modeling of Neuroscience Data, Berkeley.
2016 Jun Algorithms for modern massive datasets (MMDS), workshop, Berkeley.
2016 Jun Office of Naval Research, Computation Neuroscience Workshop, Amherst.
2016 Jun Deep learning: theory algorithms, and applications, workshop, MIT.
2016 May McGovern Institute Annual Symposium, MIT.
2016 Mar Theoretical physics and networks of real neurons, March APS Meeting, Baltimore.
2016 Mar Neuro-Inspired Computational Elements, Workshop, Berkeley.
2016 Mar Center for Mind Brain and Computation Symposium, Stanford.
2016 Feb Coding correlations and the dimensionality of neural activity, Cosyne workshop.
2016 Feb Information theory and its applications, Workshop, La Jolla, CA.
2016 Jan Physics informed machine learning workshop, Santa Fe, NM.
2015 Dec Neural circuits, from structure to computation, Workshop, Jerusalem.
2015 Dec Statistical methods for understanding neural systems, NIPS Workshop, Montreal.
2015 Dec Minds Brains and Machines, NIPS Symposium, Montreal.
2015 Nov Physics Colloquium, Sonoma State University, CA.
2015 Nov Machine Learning Seminar, UCI, Irvine, CA.
2015 Oct Condensed Matter Seminar, UC Santa Cruz.
2015 Oct Theory of Neural Computation, Mathematical Sciences Research Institute, Berkeley.
2015 Oct Physics Colloquium, UC Berkeley.
2015 Sep Plenary Talk, Collaborative Research in Computational Neuroscience, Seattle, WA.
2015 Sep Simons Global Collaboration on the Brain Workshop, New York, NY.
2015 Aug Lecturer, Minds Brains and Machines, Woods Hole, MA.
2015 Aug Lecturer, Methods for Computational Neuroscience, Woods Hole, MA.
2015 Jul Sensing, information and decision at the cellular level, ICTP Workshop, Trieste, Italy
2015 Jul Workshop on Sensing and Analysis of High-Dimensional Data, Duke University.
2015 May Computation and Neural Systems Seminar, Caltech.
2015 May NSF Symposium on Physics, Mathematics and Neuroscience of Cortical Function.
2015 Apr IBM Brain Inspired Computing Workshop, New York.
2015 Apr Austin Conference on Learning and Memory, UT Austin.
2015 Apr Simons Foundation Conference on Theory and Biology, New York.
2015 Apr Institute for Neural Computation Seminar, UCSD.
2015 Mar SIAM Computational Science and Engineering Conference.
2015 Mar Physics Colloquium, MIT.
2015 Feb Theoretical Neuroscience Seminar, Columbia University.
2015 Feb Center for Neural Science, New York University.
2014 Dec NIPS Workshop, Large scale optical physiology.
2014 Dec NIPS Workshop, Deep Learning and Representation Learning.
2014 Dec CIFAR, Neural Computation and Adaptive Perception Workshop, Montreal.
2014 Nov Learning Lunch, Baidu.
2014 Oct Center for Physics and Biology, Rockefeller University.
2014 Oct Biophysics Theory Seminar, Princeton University.
2014 Sep Brain Criticality and Networks Workshop, Hughes Research Lab.
2014 Aug Lecturer, Methods for Computational Neuroscience, Woods Hole, MA.
2014 Jul Workshop on Deep Learning and the Brain, Cognitive Science Society, Quebec City.
2014 Jul Bernstein Lecture, Center for Computational Neuroscience, Tuebingen.
2014 Jul Group for Neural Theory, Ecole Normale Superieure, Paris.
2014 Jul Bernstein workshop, Population Codes: From Data Analysis to Mechanisms, Munich.
2014 Jun Areadne Workshop on Neural Encoding and Decoding of Ensembles, Santorini.

2014 Jun Neural Population Dynamics Underlying Sensorimotor Integration, Janelia Farm.
2014 May NII-Shonan Meeting, Deep Learning: Theory, Algorithms and Applications, Tokyo.
2014 May Quantitative Theories of Learning, Memory and Prediction Workshop, Arlington, VA.
2014 Apr Physics Colloquium, Stanford University.
2014 Mar Scalable Models for High Dimensional Neural Data, Cosyne Workshop.
2014 Feb Electrical and Computer Engineering Colloquium, Carnegie Mellon University.
2014 Jan Computer Science Department, University of Montreal.
2014 Jan Information Theory Forum, Stanford University.
2013 Dec NIPS Workshop: High dimensional statistical inference in the brain.
2013 Dec Neural Information Processing Systems (NIPS) Main Meeting.
2013 Nov Swiss Computational Neuroscience Colloquium Series, Zurich.
2013 Nov Neuroscience Center Seminar, University of Geneva.
2013 Nov Statistics Colloquium, University of Chicago.
2013 Oct Computational Neuroscience Colloquium Series, University of Waterloo.
2013 Oct Stanford Bio-X 10th Anniversary.
2013 Oct Stanford Neuroscience Retreat.
2013 Aug Lecturer, Methods for Computational Neuroscience, Woods Hole, MA.
2013 Jul Brain Initiative Advisory Committee Meeting, Boston, MA.
2013 Jun Dynamics of cortical and cortical-subcortical circuits, Janelia Farm.
2013 May Temporal Dynamics of Learning, Janelia Farm.
2013 May Sensory Systems and Sensory Coding Workshop, Mathematical Biosciences Institute.
2013 Mar Networking, Communication, and DSP Seminar, Berkeley.
2013 Feb Interface of Brain and Machine Symposium, Biophysical Society Meeting, Philadelphia.
2012 Oct Challenges in Mathematical Neuroscience Workshop, MBI, Ohio.
2012 Sep Lecturer, Bernstein Center for Computational Neuroscience School, Goettingen.
2012 Jul Colloquium, Hughes Research Lab, Malibu, CA.
2012 Apr Lecturer, Random Matrix Theory for Complex Systems Course, Okinawa, Japan.
2012 Mar Neuroscience of Music Workshop, Ascona, Switzerland.
2012 Mar Neuroscience Seminar, University of Washington.
2012 Mar Center for Mind Brain and Computation Seminar, Stanford University.
2012 Mar Electrical Engineering Colloquium, Rice University.
2012 Feb Computational Neuroscience Seminar, Janelia Farm.
2012 Jan Quantitative Biology Seminar, Stanford University.
2011 Dec NSF Emerging Frontiers in Research and Innovation Workshop.
2011 Sep Brains, Minds and Models Workshop, CUNY Institute for Graduate Studies.
2011 Sep Physics Colloquium, UC Merced.
2011 Sep Dept. of Electrical Engineering Seminar, Georgia Tech.
2011 Sep Physics Colloquium, Emory University.
2011 Jul International Congress on Industrial and Applied Mathematics.
2011 Jul Telluride Neuromorphic Cognition and Engineering Workshop.
2011 Jun Collective Behavior in Biological Systems, Aspen Center for Theoretical Physics.
2011 May Bernstein Center for Computational Neuroscience Seminar, Goettingen.
2011 May Department of Mathematics Seminar, Univ. of Arizona.
2011 Apr Salk Institute for Biological Sciences.
2011 Apr Department of Brain and Cognitive Sciences Seminar, MIT.
2011 Mar Swissnex Public Lecture, San Francisco.
2011 Mar Cosyne Workshop: The role of dimensionality and sparsity in neuronal processing.
2011 Feb Computational and Systems Neuroscience Conference, Main Meeting, Salt Lake City.
2011 Feb Department of Applied Physics Seminar, Stanford University.
2011 Feb Center for Brain Science Seminar, Harvard University.
2011 Feb Center for Mind, Brain and Computation Seminar, Stanford University.

2011 Jan Institute for Neuroinformatics Seminar, ETH Zurich.
2010 Nov Biological Modeling Seminar, Stanford University.
2010 Nov Statistics Seminar, Columbia University.
2010 Oct Kavli Institute for Theoretical Physics, UCSB.
2010 May Neurotheory and Neuroengineering Seminar, Janelia Farm.
2010 Apr Networks Seminar, Dept. of Mathematics, University of Houston.
2010 Apr Neurobiology and Anatomy Department Seminar, UT Houston.
2010 Mar Applied Mathematics Seminar, Harvard University.
2010 Mar Cosyne Workshop, Persistent activity: mechanisms and functional roles.
2009 Nov Interdisciplinary Center for Neural Computation Seminar, Hebrew University.
2009 Apr Banbury Conference: Working Memory.
2009 Mar Cosyne Workshop: Dimensionality reduction for multi-channel neural recordings.
2009 Feb Computational Neurobiology Lab, Salk Institute.
2009 Jan Redwood Center for Theoretical Neuroscience Seminar, UC Berkeley.
2008 Nov Applied Mathematics Colloqium, Columbia University.
2008 Sep European Conference on Complex Systems: Working Memory in Jersualem.
2008 Apr Banbury Conference: Theoretical/Experimental Approaches to Attention.
2007 Sep Neural Coding, Computation and Dynamics, Hossegor, France.
2007 Jul Sloan-Swartz Conference, UCSD.
2007 Jun Center for Neural Science Seminar, NYU.
2007 Jun Department of Neurobiology, Yale University.
2007 Apr Gatsby Computational Neuroscience Unit, (2 seminars).
2007 Mar Gatsby Computational Neuroscience Unit, (2 seminars),
2007 Mar Department of Physiology, UCSF.
2007 Feb Cosyne Workshop, Hippocampal/entorhinal plasticity, coding and computation.
2007 Feb Condensed Matter Theory Seminar, Brandeis University.
2007 Jan Volen Center for Complex Systems, Brandeis University.
2007 Jul Sloan-Swartz Conference, Columbia University.
2007 Apr Department of Physiology, Columbia University.
2006 Mar Computational and Systems Neuroscience Conference, Main Meeting, Salt Lake City.
2005 Oct Computational Biology Seminar, UC Berkeley.