Joel Zylberberg

York University
Department of Physics and Astronomy
243 Petrie Science and Engineering Building
Toronto, ON, Canada

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Education

University of California, Berkeley, California

Ph.D. (2012), M.A. (2010), Physics

Advisor: Mike DeWeese

Dissertation: *From scenes to spikes: understanding vision from the outside in*

Simon Fraser University, Burnaby, British Columbia

B.Sc. (2008), Physics (with First Class Honors)

Academic and Research Positions

Primary Appointments

Canada Research Chair in Computational Neuroscience, York University, Toronto, Ontario (since 2019)

Associate Professor, Department of Physics and Astronomy, York University, Toronto, Ontario (since 2022)

Assistant Professor, Department of Physics and Astronomy, York University, Toronto, Ontario (2019-2022)

Assistant Professor, Department of Physiology and Biophysics, University of Colorado School of Medicine, Aurora, Colorado (2015 - 2018)

Acting Assistant Professor, Department of Applied Mathematics, University of Washington, Seattle, Washington (2012 - 2015)

Secondary Appointments

Associate Scientist, Creative Destruction Lab, Toronto, Ontario (since 2023)

Evaluating technology behind new neurotechnology startups

Mentoring founder teams in neuroscience, AI, and neurotechnology

Faculty Affiliate, Vector Institute for AI, Toronto, Ontario (since 2020)

Associate Fellow, Learning in Machines and Brains Program, Canadian Institute for Advanced Research (CIFAR), Toronto, Ontario (since 2019)

Affiliate Professor, Department of Applied Mathematics, University of Colorado, Boulder, Colorado (2016 - 2018)

Honors

Major

Sloan Research Fellowship

Google Faculty Research Award

Canadian Institute for Advanced Research (CIFAR) Azrieli Global Scholar Award

Howard Hughes Medical Institute (HHMI) International Student Research Fellowship

Fulbright Science and Technology Ph.D. Fellowship

Natural Sciences and Engineering Research Council of Canada (NSERC) Julie Payette Research Scholarship

Minor (subset)

York University Research Leader Award

"Outstanding Graduate Student Instructor" award from UC Berkeley

Publications

[+] Trainee in my lab (student or postdoctoral fellow)

Full text of all published papers available at **http://www.jzlab.org/publications.html**
Citation data available at **Google Scholar**.

C. Gillon*, J. Pina*[+], J. Lecoq, T. Henley[+], et al., Y. Bengio, T. Lillicrap, B. Richards[@], J. Zylberberg[@] (2023). Responses to pattern-violating visual stimuli evolve differently over days in somata and distal apical dendrites. *Journal of Neuroscience* (to appear). (* co-first authors; @ co-senior authors)

S. Idrees[+], F. Rieke, G.D. Field, and J. Zylberberg (2023). Biophysical neural adaptation mechanisms enable deep learning models to capture dynamic retinal computation. In revision for resubmission to *Nature Communications*. biorXiv: 2023.06.20.545728.

K. Carver[+], K. Saltoun[+], E. Christensen[+], J. Zylberberg[@], A. Abosch[@], and J. Thompson[@] (2023). Towards automated sleep-stage classification to enable adaptive deep brain stimulation targeting sleep in Parkinson's disease. *Communications Engineering*, 2: 95. (@ co-senior authors).

C. Gillon*, J. Lecoq*, J. Pina[+], T. Henley[+], et al., Y. Bengio, T. Lillicrap, J. Zylberberg[@], and B. Richards[@] (2023). Responses of mouse visual cortical pyramid cell somata and apical dendrites over multiple days. *Scientific Data*, 10: 287. (* co-first authors; @ co-senior authors)

C. Efird, A. Murphy, J. Zylberberg, and A. Fyshe (2023). Identifying Shared Decodable Concepts in the Human Brain Using Image-Language Foundation Models. arXiv:2306.03375 [cs.AI].

D. Tang, J. Zylberberg, X. Jia, and H. Choi (2023). Stimulus-dependent functional network topology in mouse visual cortex. biorXiv: 2023.07.03.547364.

R. Gerum[+], C. Pirlot, A. Fyshe, J. Zylberberg (2022). Different spectral representations in optimized artificial neural networks and brains. arXiv:2208.10576 [cs.LG].

C. Pirlot, R. Gerum[+], C. Effird, J. Zylberberg, A. Fyshe (2022). Improving the accuracy and robustness of CNNs using a deep CCA neural data regularizer. arXiv:2209.02582 [cs.CV].

N.A. Cayco Gajic and J. Zylberberg (2021). Good decisions require more than information. *Nature Neuroscience* 24: 903-904.

K. Ruda, J. Zylberberg, G.D. Field (2020). Ignoring correlated activity causes a failure of retinal population codes. *Nature Communications* 11: 4605.

C. Federer[+], H. Xu, A. Fyshe, J. Zylberberg (2020). Improved object recognition using neural networks trained to mimic the brain's statistical properties. *Neural Networks* 131: 103-114.

J. Cafaro, J. Zylberberg, G.D. Field (2020). Global motion processing by populations of direction-selective retinal ganglion cells. *Journal of Neuroscience* 40: 5807-5819.

S. Jones[+], J. Zylberberg, N. Schoppa (2020). Cellular and synaptic mechanisms that differentiate mitral cells and superficial tufted cells into parallel output channels in the olfactory bulb. *Frontiers in Cellular Neuroscience* 14: 614377.

E. Christensen[+] and J. Zylberberg (2020). Models of the primate ventral stream that categorize and visualize images. bioRxiv: 10.1101/2020.02.21.958488.

B. Richards, T. Lillicrap, *et al.*, J Zylberberg, D. Therien, K. Kording (2019). A deep learning framework for neuroscience. *Nature Neuroscience* 22: 1761-1770.

J.A. Pruszynski and J. Zylberberg (2019). The language of the brain: Real-world neural population codes. *Current Opinion in Neurobiology* 58: 30-36.

W. Kindel[+], E. Christensen[+], J. Zylberberg (2019). Using deep learning to probe the neural code for images in primary visual cortex. *Journal of Vision* 19: 29.

M. Lintz, J. Essig, J. Zylberberg, G. Felsen (2019). Spatial representations in the superior colliculus are modulated by competition among targets. *Neuroscience* 408: 191-203.

N.A. Cayco Gajic, S. Durand, M. Buice, R. Iyer, C. Reid, J. Zylberberg*, E. Shea-Brown* (2019). Transformation of population code from dLGN to V1 facilitates linear decoding. bioRxiv: 10.1101/826750. (* co-senior authors who contributed equally to this work)

E. Christensen[+], A. Abosch, J. Thompson*, J. Zylberberg* (2018). Inferring sleep stage from local field potentials recorded in the subthalamic nucleus of Parkinson's patients. *Journal of Sleep Research* e12806. (* co-senior authors who contributed equally to this work)

N.A. Cayco Gajic, J. Zylberberg, E. Shea-Brown (2018). A moment-based maximum entropy model for fitting higher-order interactions in neural data. *Entropy* 20: 489.

C. Federer[+] and J. Zylberberg (2018). A self-organizing short-term dynamical memory network. *Neural Networks* 106: 30-41.

J. Zylberberg, A. Pouget, P.E. Latham, E. Shea-Brown (2017). Robust information propagation through noisy neural circuits. *PLoS Computational Biology* 13: e1005497.

J. Zylberberg and B. Strowbridge (2017). Mechanisms of persistent activity in cortical circuits: possible neural substrates for working memory. *Annual Review of Neuroscience* 40: 603-627.

J. Zylberberg (2017). The role of untuned neurons in sensory information coding. bioRxiv: 10.1101/134379.

J. Zylberberg*, J. Cafaro*, M. Turner*, E. Shea-Brown, F. Rieke (2016). Direction-selective circuits shape noise to ensure a precise population code. *Neuron* 89: 369-383. (* co-first authors who contributed equally to this work)

J. Zylberberg, R. Hyde, B.W. Strowbridge (2016). Dynamics of robust pattern separability in the hippocampal dentate gyrus. *Hippocampus* 26: 623-632.

J. Zylberberg and E. Shea-Brown (2015). Input nonlinearities can shape beyond-pairwise correlations and improve information transmission by neural populations. *Physical Review E* 92: 062707.

N.A. Cayco Gajic, J. Zylberberg, E. Shea-Brown (2015). Triplet correlations among similarly tuned cells impact population coding. *Frontiers in Computational Neuroscience* 9: 57.

Y. Hu, J. Zylberberg, E. Shea-Brown (2014). The sign rule and beyond: Boundary effects, flexibility, and noise correlations in neural population codes. *PLoS Computational Biology* 10: e1003469.

J. Zylberberg and M.R. DeWeese (2013). Sparse coding models can exhibit decreasing sparseness while learning sparse codes for natural images. *PLoS Computational Biology* 9: e1003182.

P. King, J. Zylberberg, M.R. DeWeese (2013). Inhibitory interneurons decorrelate excitatory cells to drive sparse code formation in a spiking model of V1. *Journal of Neuroscience* 33: 5475-5485.

J. Zylberberg, D. Pfau, M.R. DeWeese (2012). Dead leaves and the dirty ground: low-level image statistics in transmissive and occlusive imaging environments. *Physical Review E* 86: 066112.

J. Zylberberg, J. Murphy, M.R. DeWeese (2011). A Sparse Coding Model with Synaptically Local Plasticity and Spiking Neurons Can Account for the Diverse Shapes of V1 Simple Cell Receptive Fields. *PLoS Computational Biology* 7: e1002250.

J. Zylberberg and M.R. DeWeese (2011). How should prey animals respond to uncertain threats? *Frontiers in Computational Neuroscience* 5: 20.

G. Zhao, L. Pogosian, A. Silvestri, J. Zylberberg (2009). Cosmological Tests of General Relativity with Future Tomographic Surveys. *Physical Review Letters* 103: 241301.

G. Zhao, L. Pogosian, A. Silvestri, J. Zylberberg (2009). Searching for modified growth patterns with tomographic surveys. *Physical Review D* 79: 083513.

C. Vockenhuber *et al.* (2008). Improvements of the DRAGON recoil separator at ISAC. *Nuclear Instruments and Methods in Physics Research B* 266: 4167-4170.

J. Zylberberg *et al.* (2007). Charge-state distributions after radiative capture of helium nuclei by a carbon beam. *Nuclear Instruments and Methods in Physics Research B* 254: 17-24.

J. Zylberberg, A.A. Belik, E. Takayama-Muromachi, Z.-G. Ye (2007). Bismuth Aluminate: A New High-T_C Lead-Free Piezo-/ferroelectric. *Chemistry of Materials* 19: 6385-6390.

J. Bechhoefer, Y. Deng, J. Zylberberg, C. Lei, Z.-G. Ye (2007). Temperature dependence of the capacitance of a ferroelectric material. *American Journal of Physics* 75: 1046-1053.

J. Zylberberg and Z.-G. Ye (2006). Improved dielectric properties of bismuth-doped $LaAlO_3$. *Journal of Applied Physics* 100: 086102.

Patents

J. Zylberberg, E. Christensen[+], A. Abosch, and J. Thompson. Deep brain stimulation using artificial neural networks. U.S. Patent Application 17/292,634, filed January 6, 2022.

Successful Proposals

Current Funding

Natural Science and Engineering Research Council (NSERC) of Canada, Discovery Grant: Observable signatures of learning in neural circuits (2019–2025). Role: P.I. ($246,000 CAD, plus $12,500 Discovery Launch Supplement)

York University VISTA Initiative, Pilot Grant: Foundation Models for Visual Neuroscience (2023-2025). Role: P.I. ($49,500 CAD)

CIFAR Catalyst Grant: Foundation Models for Neuroscience (2023-2024). Role: P.I. (along with Blake Richards; this is a collaborative grant) ($54,000 CAD)

Canada Research Chair (Tier II) in Computational Neuroscience (2019–2029). Role: P.I. ($1,100,000 CAD) (Renewal approved in 2023 for 2024-2029 funding period).

Fields Institute for Mathematical Sciences, Shared Graduate Course Grant: Deep Learning for Natural Scientists (2023–2023). Role: P.I. ($10,000 CAD)

NIH BRAIN Initiative UH3 Grant: Adaptive Neurostimulation to Restore Sleep in Parkinson's Disease: An Investigation of STN LFP Biomarkers In Sleep Dysregulation and Repair (2020–2025). Role: co-Investigator (P.I.s: Aviva Abosch, Clete Kushida, Casey Halpern, and John Thompson. $5,647,425 USD)

Completed Funding

New Frontiers Research Fund, Exploration Grant: Training AI systems with brain activation patterns of human experts during vision-based tasks (2020–2023). Role: co-P.I. (P.I.: Alona Fyshe. $249,500 CAD)

A.P. Sloan Foundation, Sloan Research Fellowship in Neuroscience (2017–2021). Role: P.I. ($60,000 USD)

Canadian Institute for Advanced Research (CIFAR), Catalyst Grant: Teaching computers to think about images the way brains do (2018–2019). Role: P.I. (co-P.I.: Alona Fyshe. $50,000 CAD)

University of Colorado, Physiology Pilot Grant: The functional role of cerebellar input to the superior colliculus in controlling orienting movements (2018–2019). Role: P.I. (along with Gidon Felsen and Abigail Person; this is a collaborative grant) ($50,000 USD)

Google Inc., Google Faculty Research Award in Computational Neuroscience: Using deep learning to automatically "crack" neural population codes (2017–2018). Role: P.I. ($40,377 USD)

Canadian Institute for Advanced Research (CIFAR), Catalyst Grant: Identifying the brain's learning rules from in vivo neural data (2017–2018). Role: P.I. (along with Blake Richards; this is a collaborative grant) ($52,950 CAD)

Canadian Institute for Advanced Research (CIFAR), Azrieli Global Scholar Award for Learning in Machines and Brains (2016–2018). Role: P.I. ($100,000 CAD)

Competitively Allocated Facilities

Allen Institute for Brain Science, OpenScope: Predictive Learning and Somato-dendritic Coupling (2022–2023). Role: P.I. (along with Blake Richards; this is a collaborative project) ($\sim$90 2-photon Ca^{2+} imaging sessions in mouse visual cortex)

Allen Institute for Brain Science, OpenScope: Identifying the role of top-down feedback connections in cortical learning and inference (2018–2019). Role: P.I. (along with Blake Richards, Yoshua Bengio, and Tim Lillicrap; this is a collaborative project) ($\sim$50 2-photon Ca^{2+} imaging sessions in mouse visual cortex)

Press

The Mirage article, Scientists Uncover Brain Processes Behind Vision. Nov. 22, 2023.

EurekAlert! article, New research to understand how the brain handles optical illusions and makes predictions. May. 11, 2022.

York University Magazine article, Stimulating Treatment. Feb. 23, 2021.

Scientific American article, What Mice Watching Orson Welles's *Touch of Evil* Can Teach Scientists about Vision. Dec. 19, 2019.

Voices of VR podcast, Computational Neuroscience, Perception, Machine Learning, & the Dream of Restoring Lost Senses. Sept. 12, 2019.

Axios article, Looking to AI to understand how we learn. Aug. 8, 2019.

Geekwire article, OpenScope gives neuroscientists time on Allen Institute's telescope for the brain. Jul. 26, 2018.

Data Stories (video produced by the Allen Institute for Brain Science), Untuned but not irrelevant. Jun. 19, 2018.

Invited Talks & Seminars (subset)

Symposium on *Surprise! Cortical prediction errors in learning and behavior*, Federation of European Neuroscience Societies (FENS) Forum, Vienna, Austria (Upcoming: June 2024).

Summer Workshop on the Dynamic Brain, Friday Harbor, Washington (Aug. 2023)

Workshop on *Dendritic computations and neuro-inspired AI*, Computational and Systems Neuroscience (CoSyNe) Conference, Mont Tremblant, Quebec (Mar. 2023)

Montreal AI & Neuroscience Conference (MAIN), Montreal, Quebec (Dec. 2022)

Winter School on Brains and Computation, San Diego, California (Dec. 2022)

Canadian Brain Research Strategy Leadership Retreat, Quebec City, Quebec (Nov. 2022)

Workshop on *How can we optimally use neuroscience data to guide the next generation of brain models of primate visual and linguistic cognition?*, Computational and Cognitive Neuroscience (CCN) Conference, San Francisco, California (Aug. 2022)

AI Week Symposium, Alberta Machine Intelligence Institute (amii), Edmonton, Alberta (May 2022)

Computational Neuroscience Initiative Basel (CNIB) Seminar, Friedrich Miescher Institute for biomedical research, online (Apr. 2022)

Seminar, Krembil Institute for Neuroinformatics, online (Apr. 2021)

Open for (neuro)science Symposium, Allen Institute for Brain Science, online (Mar. 2021)

Physics Seminar, Dalhousie University, online (Nov. 2020)

Physics Seminar, l'Université d'Ottawa, online (Oct. 2020)

Workshop on *Open Data, Tools, and Models from the Allen Institute Supporting Systematic Computational Studies in Neuroscience*, Computational Neuroscience Society (CNS) Conference, online (Jul. 2020)

Physics Colloquium, Washington University, St. Louis, Missouri (Sept. 2019)

International Conference on Predictive Vision, Toronto, Ontario (Jun. 2019)

Computational Neuroscience Seminar, Gatsby Unit, University College London (UCL), London, UK (Apr. 2019)

Centre for Theoretical Neuroscience Seminar, University of Waterloo, Waterloo, Ontario (Mar. 2019)

CIFAR - Helmholtz Foundation Workshop on AI for Neuroscience, Toronto, Ontario (Jan. 2019)

Neuroscience Seminar, Allen Institute for Brain Science, Seattle, Washington (Aug. 2018)

Workshop on *Interactions Between Brain Areas*, Computational and Systems Neuroscience (CoSyNe) Conference, Breckenridge, Colorado (Mar. 2018)

Visual Science Seminar, York University, Toronto, Ontario (Feb. 2018)

Computational Neuroscience Seminar, Western University, London, Ontario (Jan. 2018)

Computer Science Colloquium, University of Victoria, Victoria, British Columbia (Aug. 2017)

Neuroscience Seminar, National Institutes of Health (NIH), Bethesda, Maryland (May 2017)

Neuroscience Seminar, Institut d'Investigacions Biomediques August Pi Sunyer, Barcelona, Spain (Dec. 2016)

Dynamics and Complex Systems Seminar, University of Colorado, Boulder, Colorado (Sept. 2016)

Rocky Mountain Regional Neuroscience Group Annual Conference, Aurora, Colorado (May 2016)

Workshop on *Connecting Network Architecture and Network Computation*, **Banff International Research Station (BIRS)**, Banff, Alberta (Dec. 2015)

Methods of Information Theory **Workshop, Computational Neuroscience Society Conference**, Prague, Czech Republic (Jul. 2015)

Neuroscience Seminar, Stanford University, Stanford, California (Mar. 2015)

Brain and Cognitive Sciences Seminar, Massachusetts Institute of Technology (MIT), Cambridge, Massachusetts (Feb. 2015)

Mathematics and Neuroscience Seminar, University of Texas, Austin, Texas (Jan. 2015)

Communications, Networks, and Systems Seminar, University of Southern California, Los Angeles, California (Jan. 2015)

Mathematics Seminar, Monash University, Melbourne, Australia (Nov. 2014)

Workshop on *Biological and Bio-Inspired Information Theory*, **Banff International Research Station (BIRS)**, Banff, Alberta (Oct. 2014)

Biophysics Seminar, Simon Fraser University, Burnaby, British Columbia (Sept. 2014)

Seminar on Computational Neuroscience, Ecole Polytechnique Federale de Lausanne (EPFL), Lausanne, Switzerland (Oct. 2013)

Computational Neuroscience Seminar, University of Washington, Seattle, Washington (Feb. 2012)

Research Mentoring

Postdoctoral Fellows

Richard Gerum, York University (2021 - ; training AI systems with brain activation patterns).

Saad Idrees, York University (2020 - ; deep learning models of retinal responses to stimulation). Winner of VISTA Distinguished Postdoctoral Fellowship.

Jay Pina, York University (2019 - ; observable correlates of learning in neural circuits).

Will Kindel, University of Colorado School of Medicine (2016 - 2018; deep learning models of visual cortex). Now at Sandia National Laboratory.

Doctoral Students

Alex Heyman, York University (2023 - ; neuro-inspired deep learning algorithms). Winner of Vector Institute for AI Master's Fellowship (2021).

Tim Henley, York University (2019 - ; credit assignment in neural circuits). Winner of Ontario Graduate Scholarship (2023) and MITACS Research Training Award (2020).

Shelly Jones, University of Colorado School of Medicine (2016 - 2020; role of gap junctions in the olfactory system). Winner of NIH National Research Service Award (Ph.D. Fellowship; 2018). Now at the Colorado Office of State Planning and Budgeting.

Elijah Christensen, University of Colorado School of Medicine (2017 - 2020 ; deep learning models of the ventral stream). Winner of National Defense Science and Engineering Graduate Fellowship (NSDEG, Ph.D. Fellowship; 2019). Now at U. Colorado Medical school as Resident Physician.

Callie Federer, University of Colorado School of Medicine (2016 - 2019; deep learning models trained to mimic the brain). Winner of NSF Graduate Research Fellowship (Ph.D. Fellowship; 2017). Now at Choozle.

Masters Students

Alex Heyman, York University (2021 - 2023 ; neuro-inspired deep learning vision algorithms). Winner of Vector Institute for AI Master's Fellowship (2021).

Gaurav Chanda, University of Washington (2014 - 2015; smoothness priors to improve nonlinear dimensionality reduction). Now at Amazon.

Undergraduate Students

Katrina Carver, York University (2022; neural network ensembles for predicting sleep stages of Parkinson's patients). Winner of NSERC Undergraduate Summer Research Award.

Jaba Adams, York University (2020 - 2022; integrated information in recurrent artificial neural networks). Winner of York University Dean's Undergraduate Research Award.

Karin Saltoun, York University (2019 - 2020; developing AI algorithms to control next-generation adaptive DBS implants for Parkinson's patients). Winner of NSERC Undergraduate Summer Research Award.

Audrey Tsoi, University of Colorado School of Medicine (2018 - 2019; modelling direction-selective neurons in retina).

Chelsey Wildenborg, University of Colorado School of Medicine (2016; encoding multiple stimulus features in neural population activities).

Jacob Jaminet, University of Colorado School of Medicine (2016; encoding multiple stimulus features in neural population activities).

Nile Graddis, University of Washington (2014 - 2015; representation of time in the hippocampus).

Jason Murphy, Berkeley City College and UC Berkeley Helen Wills Neuroscience Institute (2010-2011; fitting model V1 receptive fields with Gabor functions).

Marvin Thielk, UC Berkeley (2011; creating minimum-wiring configurations for network models with known inter-neuronal connectivity).

Research Interns

Niloufar Ghazavi, UCLA (2023; ML models that incorporate biological adaptation mechanisms).

Ines Ben Haj Kacem, Ecole Normale Superieure, Paris (2022; ML models that incorporate biological adaptation mechanisms).

Thesis Committee Participation

Harrish Thasarathan, York University (2023; Key-frame based transformer models for human motion forecasting)

Cassidy Pirlot, University of Alberta (2022; improving CNNs using a deep CCA neural regularizer).

Samuel Budoff, University of Colorado School of Medicine (2022 - ; topography of ganglion cells in mouse retina).

Bozorgmehri-Fard, Kasra, York University (2022 - ; modelling CO_2 ice deposits on mars).

Saeed Ghorbani, York University (2022 - ; exploiting novel deep learning architectures in character animation pipelines).

Claire Lauzon, York University (2022; role of the ventromedial prefrontal cortex in mnemonic discrimination).

Olha Fedoryk, York University (2021 - ; modelling the active biomechanics of the inner ear).

Anirudh Krishnadas, York University (2021 - ; computational modelling of potential energy landscapes in clusters of metal atoms).

Amanda Jass, York University (2021; synaptic plasticity in mouse models of autism spectrum disorder).

Matt Becker, University of Colorado School of Medicine (2016 - 2020 ; cerebellar control of movement).

Jaclyn Essig, University of Colorado School of Medicine (2016 - 2021 ; target selection in the superior colliculus).

Madhi Biparva, York University (2019; Top-down selection in convolutional neural networks).

Service as External Examiner for Ph.D. Thesis

Nathan Wispinski, University of Alberta (2023; dynamic decision making).

Marina Melek, University of Waterloo (2021; application of machine learning to optical communication systems).

Teaching Experience

Undergraduate

Instructor: York University, Physics 4310 *Physics or Astronomy Project* (Winter 2021, Winter 2022); York University, Physics 3090 *Methods in Theoretical Physics* (Autumn 2020, Autumn 2021; Autumn 2022; Autumn 2023); York University, Physics 2010 *Introduction to Classical Mechanics* (Winter 2019); University of Washington, Applied Mathematics 402 *Introduction to Dynamical Systems and Chaos* (Winter 2013, Winter 2014, Winter 2015)

Guest lecturer: York University, Physics 2060 *Optics* (Winter 2020); York University, Biophysics 4090 *Biophysical Techniques* (Winter 2019); University of Washington, Mathematics 498 *Undergraduate Mathematical Sciences Seminar* (Winter 2014)

Graduate School

Instructor: York University, Physics 6060 *Advanced Topics in Theoretical Physics: Deep Learning for Natural Scientists* (Autumn 2021; Autumn 2022; Autumn 2023); University of Washington, Applied Mathematics 502 *Introduction to Dynamical Systems and Chaos* (Winter 2013, Winter 2014, Winter 2015)

Co-instructor: University of Colorado Denver, Neuroscience 7674 / Electrical Engineering 5375 *Engineering / Quantitative Neuroscience* (Autumn 2016, Autumn 2017)

Guest Lecturer: University of Colorado Denver, Neuroscience 7501 *Introduction to Neuroscience* (Autumn 2016, Autumn 2017, Autumn 2018); University of Colorado Denver, Computational Bioscience 7711 *Methods and Tools in Biomedical Informatics* (Autumn 2016, Autumn 2017); University of Colorado Denver, Neuroscience 7657 *MatLab for Neuroscientists* (Summer 2016); University of Colorado Denver, Neuroscience 7610 *Fundamentals of Neurobiology* (Winter 2016); University of Colorado Denver, Computational Bioscience 7712 *Research Methods in Biomedical Informatics* (Winter 2016, Winter 2017, Winter 2018); University of Washington, Computer Science and Engineering 590 *Special topics – Molecular and Neural Computation* (Winter 2014); University of Washington, Applied Mathematics 500J *Special Topics in Applied Mathematics* (Spring 2013)

Medical School

Lecturer: University of Colorado School of Medicine, *Molecules to Medicine* (Autumn 2016, Autumn 2017, Autumn 2018)

Extra-Curricular Teaching Experience

Instructor, Allen Institute for Brain Science / University of Washington Summer Workshop on the Dynamic Brain (2023). This is a 2-week summer course for senior graduate students and postdocs from all over the world.

Lecturer, York University Centre for Vision Research Summer School (2019, 2020, 2022). This is a 1-week vision science summer course for undergrads from all over the world.

Faculty Mentor, Neuromatch Academy (2020). This is an online summer course in computational neuroscience.

Co-director of the *Colorado Biomedical Informatics Summer Training Program* (2016, 2017). This is an 8-week summer program, including coursework and research experience, that introduces undergraduates from underrepresented minority (URM) groups to computational biology. The program is funded by a NIH T15 grant.

Workshop designer and instructor, University of Washington *STEM Bridge* research experience for incoming undergraduates (2013).

Teaching assistant and workshop designer, University of Calgary, *Shad Valley program* (2004, 2005, 2008). This is a month-long summer program that introduces gifted high school students to advanced topics in science, engineering, and entrepreneurship.

Professional Service

Co-organizer of Workshops: CIFAR workshop *Foundation models for neuroscience* (Oct. 2022); Computational and Systems Neuroscience (CoSyNe) workshop *Brain-Score and beyond: confronting brain-like ANNs with neuroscientific data* (Mar. 2022); Banff International Research Station (BIRS) workshop *Dynamical Principles of Biological and Artificial Neural Networks* (Jan. 2022); CoSyNe workshop *Non-canonical neural responses: Where do they come from and what do they do?* (Mar. 2020); *Mathematics of Vision* workshop, Fields Institute for Mathematical Sciences (Oct. 2019)

Member of the Steering Committee for the Allen Institute for Brain Science OpenScope (2021 - ongoing)

Program Committee Member: Computational and Systems Neuroscience Conference (CoSyNe) (2016 - 2020); International Conference on Mathematical Neuroscience (ICMNS) (2016)

Reviewer for funders: CIFAR Azrieli Global Scholars; CIFAR Catalyst grants; NSERC Discovery grants; Agence Nationale de la Recherche (France) Research Grants; Allen Institute for Brain Sciences OpenScope; KU Leuven Research Council C1 grant; Canadian Foundation for Innovation (CFI) John. R. Evans Leaders Fund; Fields Institute for Research in Mathematical Sciences General Scientific Activities.

Editorial Service: Associate Editor for *Frontiers in Neuroscience*; Member of Inaugural Editorial Board for *Neurons, Behavior, Data Analysis, and Theory (NBDT)*

Reviewer for journals: *eLife; PLoS Biology; Cell; Nature Neuroscience; Neuron; Journal of Neuroscience; Nature Communications; Cell Reports; PLoS Computational Biology; Science Advances; Trends in Neurosciences; Vision Research; Journal of Vision; Journal of Neurophysiology; Neural Computation; Neural Networks; Journal of Neural Engineering; Biological Cybernetics; Entropy; Journal of Computational Neuroscience; F1000 Research (Faculty of 1000); IEEE Transactions on Molecular, Biological, and Multi-Scale Communications; Hearing Research; Frontiers in Computational Neuroscience; International Journal of Neural Systems; Journal of Zoology*

Reviewer for conferences: *Neural Information Processing Systems (NeurIPS) Conference; International Conference on Learning Representations (ICLR); International Conference on Machine Learning (ICML); Association for the Advancement of AI (AAAI) Conference on Artificial Intelligence; CoSyNe conference; International Conference on Mathematical Neuroscience (ICMNS)*

Session Chair: Computational and Systems Neuroscience Conference (CoSyNe) (2017, 2018); International Conference on Mathematical Neuroscience (ICMNS) (2017); March Meeting of the American Physical Society (2013)

Co-chair of the organizing committee for the 2007 Canadian Undergraduate Physics Conference (2007)

Institutional Service (subset)

Associate Director of York University's Centre for Integrative and Applied Neuroscience (2023 - ongoing)

Member of York University's SPORT (Strategic Project and Opportunity Review Team) Research Chair Adjudication Committee (2020 - ongoing)

Member of York University's Department of Physics and Astronomy Graduate Program Executive Committee (2020 - ongoing)

Vice Chair of York University Faculty of Science Strategic Plan Advisory Board (2020 - 2021)

Member of York University's VISTA (Vision: Science To Application) Performance Monitoring Committee (2019-2022. Interim chair from 2021-2022)

Member of York University Department of Physics and Astronomy Tenure and Promotion Adjudication Committee (2020)

Member of the Organizing Committee for the York University Centre for Vision Research Summer School (2020)

Co-organizer of the Physics Colloquium series at York University (2019 - 2020)

Faculty Senator, University of Colorado School of Medicine (2016 - 2018)

New Faculty Search Committee Member, Dept. of Physiology and Biophysics, University of Colorado School of Medicine (2016-2018)

Organizer of the Quantitative Systems Neuroscience Journal Club at the University of Colorado Medical School (2015 - 2018)

Co-organizer of the Boeing Distinguished Speaker Series in Applied Mathematics at the University of Washington (2012 - 2015)

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