Eric Elmoznino

Artificial Intelligence
Cognitive Neuroscience

Contact
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Websites

Education

PhD | Computer Science
Mila (Université de Montréal)
2022-Now

MA | Cognitive Science
Johns Hopkins University
2019-2020

BASc | Computer Engineering
University of Toronto
2014-2019

DCS | Health Sciences
Dawson College
2012-2014

Skills

Languages/Frameworks
Python, PyTorch, TensorFlow, sklearn, Matlab, C++, C, C#, Swift/iOS, JavaScript, HTML, CSS, Flask, LaTeX

Subjects/Techniques
ML, Deep learning, MVPA, Computational modeling, Human vision, Linguistics, Full-stack web

Spoken Languages
English, French (Fluent in both)

Interests

Mind, Brain, and AI
Consciousness, Compositionality, In-context learning, Causality, Knowledge representation, OOD generalization, Lifelong learning, Vision

Public Speaking
Technical presentations, Teaching

Other Disciplines
Data Science, Genetics, Astrophysics, Philosophy of mind, Epistemology

Hobbies
Reading, Piano, Meditation, Snowboarding, Tennis, Basketball

Research Positions & Work Experience

2022-Now **AI Researcher (PhD)** Mila (Université de Montréal), Montreal, QC
Development of AI with inductive biases from conscious high-level cognition, supervised by Profs. Guillaume Lajoie and Yoshua Bengio

2020-Now **Data Science Instructor** Lighthouse Labs, Toronto, ON
Teach lectures on machine learning topics at a full-time data science bootcamp to students with no prior coding experience

2019-2022 **Cognitive Science Researcher (MA)** Johns Hopkins University, Baltimore, MD
Research on information representation and algorithms in the visual system of the human brain with Prof. Michael Bonner

2021 **Computational Neuroscience TA** Neuromatch Academy, Remote
Lead groups of students through tutorial exercises ○ Review lecture material and answer student questions

2017-2019 **Machine Learning Researcher** ModiFace, Toronto, ON
Work on computer vision machine learning models for the beauty industry ○ Research papers on makeup rendering and skin condition diagnostics using deep learning

2018 **Computer Vision Contractor** Precious, Remote
Work on computer vision machine learning models related to facial perception for a mobile app that automatically makes photo albums of babies for new parents

2016 **Software Developer Intern** Orbis Investments, Vancouver, BC
Full-stack web development using AngularJS, Angular Material, ASP.NET MVC, Web API, and SQL Server in order to improve internal workflow efficiency for financial reporting

2012-2014 **Private, Infantry Division** Canadian Armed Forces (Reserves), Valcartier, QC
Discipline and weapons training ○ Participation in combat and reconnaissance exercises

Highlighted projects

2023-Now **Representational complexity and compositionality**
Deriving a formal quantitative definition of compositionality using ideas from algorithmic complexity theory

2023-Now **Compositional attractor models of human thought**
Learning discrete and compositional models of conscious human thought using neural network attractor dynamics ○ Accounting for ineffability in explaining away the “hard problem” of consciousness

2024-Now **In-context learning and Occam’s Razor**
A normative theory of in-context learning as a meta-learning algorithm for fitting the simplest model that explains the training data

2022-2023 **Sampling compositions of modular neural networks**
Jointly learning a set of neural network modules and how to sample context-conditioned compositions of them using GFlowNets

2021-2022 **Dimensionality and Manifold Geometry of Visual Representations**
Quantifying the relationship between the geometry of neural network representations and their similarities to visual cortex

2020-2021 **Multiplicative Feature Interactions as Neural Computations**
Investigation into multiplicative interactions between features as a canonical neural computation ○ Use in models of neural data

2019-2020 **Stimulus Synthesis for Brain Region Manipulation**
Generative model of images that would elicit a desired pattern of brain activity in a given region ○ Behavioural experiments

2020 **Language Model With Inductive Bias For Compositional Grammar**
Tree-RNN provided part-of-speech tags and sentence parses in order to learn compositional representations of language

Publications

2024 **Amortizing intractable inference in large language models.** Edward J. Hu, Moksh Jain, Eric Elmoznino, Younesse Kaddar, Guillaume Lajoie, Yoshua Bengio, Nikolay Malkin *ICLR talk – best paper honorable mention*

2024 **Sources of Richness and Ineffability for Phenomenally Conscious States.** Eric Elmoznino, Xu Ji, George Deane, Axel Constant, Guillaume Dumas, Guillaume Lajoie, Jonathan Simon, Yoshua Bengio *Neuroscience of Consciousness*

2024 **High-performing neural network models of visual cortex benefit from high latent dimensionality.** Eric Elmoznino & Michael F. Bonner *PLOS Computational Biology*

2024 **Does learning the right latent variables necessarily improve in-context learning?** Eric Elmoznino, Sarthak Mittal, Leo Gagnon, Sangnie Bhardwaj, Dhanya Sridhar, Guillaume Lajoie *ICLR Workshop poster*

2024 **Convolutional architectures are cortex-aligned de novo** Atlas Kazemian, Eric Elmoznino, Michael F. Bonner *Preprint*

2023 **Discrete, compositional, and symbolic representations through attractor dynamics.** Andrew Nam, Eric Elmoznino, Nikolay Malkin, Chen Sun, Yoshua Bengio, Guillaume Lajoie *NeurIPS Workshop talk*

2023 **Consciousness in Artificial Intelligence: Insights from the Science of Consciousness.** Patrick Butlin, Robert Long, Eric Elmoznino, Yoshua Bengio, Jonathan Birch, Axel Constant, George Deane, Stephen M. Fleming, Chris Frith, Xu Ji, Ryota Kanai, Colin Klein, Grace Lindsay, Matthias Michel, Liad Mudrik, Megan A. K. Peters, Eric Schwitzgebel, Jonathan Simon, Rufin VanRullen *Preprint*

2023 **Scene context is predictive of unconstrained object similarity judgments.** Caterina Magri, Eric Elmoznino, Michael F. Bonner *Cognition*

2023 **Learning Macro Variables with Auto-encoders.** Maitreyi Swaroop, Eric Elmoznino, Dhanya Sridhar *Neurips Workshop poster*

2020 **Visual representations derived from multiplicative interactions.** Eric Elmoznino & Michael F. Bonner *NeurIPS Workshop poster*

2019 **A new procedure, free from human assessment that automatically grades some facial skin structural signs. Comparison with assessments by experts, using referential atlases of skin ageing.** Jiang R., Kezele I., Levinshtein A., Flament F., Zhang J., Elmoznino E., Ma J., Ma J., Coquide J., Arcin V., Omoyuri E., Aarabi P. *International Journal of Cosmetic Science*

Invited Talks & Podcasts

2024 Consciousness, ineffability, and AI safety — *Mila AI Safety Reading Group*
2023 Sampling discrete objects through continuous attractor dynamics — *Mila GFlowNet Reading Group*
2023 Why can't we describe our conscious experiences? An information theoretic attractor dynamics perspective of ineffability — *Computational Phenomenology Group*
2023 Why can't we describe our conscious experiences? An information theoretic attractor dynamics perspective of ineffability — *Active Inference Institute podcast*
2023 Why can't we describe our conscious experiences? An attractor dynamics perspective of the ineffability of qualia — *University of Toronto guest lecture*
2020 How does the brain work? Cognitive science research — *SABES*
2020 Introduction to Programming with Python — *UofTHacks*

Supervision

2023 **Maitreyi Swaroop** Mila, Montreal, QC
Masters (Mathematics and Computing)

2021-22 **Atlas Kazemian** Johns Hopkins University, Baltimore, MD
Masters (Cognitive Science)

2020-21 **Adyant Balaji** Johns Hopkins University, Baltimore, MD
Undergraduate (Computer Engineering & Cognitive Science)

2019-20 **Maro Maged Doce** Johns Hopkins University, Baltimore, MD
Undergraduate (Neuroscience)

Patents

2022 **System and method for image processing using deep neural networks.** Levinshtein A., Chang C., Phung E., Kezele I., Guo W., Elmoznino E., Jiang R., Aarabi P. *U.S. Patent No. 11216988*. Washington, DC: U.S. Patent and Trademark Office

2021 **Image-to-image translation using unpaired data for supervised learning.** Elmoznino E., Kezele I., Aarabi P. *U.S. Patent Application No. 17096774*. Washington, DC: U.S. Patent and Trademark Office

2020 **System and method for augmented reality using conditional cycle-consistent generative image-to-image translation models.** Elmoznino E., Ma H., Kezele I., Phung E., Levinshtein A., Aarabi P. *U.S. Patent Application No. 16683398*. Washington, DC: U.S. Patent and Trademark Office

2020 **Machine image colour extraction and machine image construction using an extracted colour.** Elmoznino E., Aarabi P., Zhang Y. *U.S. Patent Application No. 16854975*. Washington, DC: U.S. Patent and Trademark Office

2020 **Automatic image-based skin diagnostics using deep learning.** Jiang R., Ma J., Ma H., Elmoznino E., Kezele I., Levinshtein A., Charbit J., Despois J., Perrot M., Antoinin F., Flament R.S., Parham A. *U.S. Patent Application No. 16702895*. Washington, DC: U.S. Patent and Trademark Office

Other Activities

2018 **Instructor for ECE1780** University of Toronto, Toronto, ON
Taught lectures for a graduate course on DNNs deployed to mobile devices under Prof. Parham Aarabi

2015-16 **Finance Chair** Electrical and Computer Engineering Club, Toronto, ON
Elected by peers at the University of Toronto to manage the club budget and plan social activities

2014-15 **Class Representative** Electrical and Computer Engineering Club, Toronto, ON
Elected by peers at the University of Toronto to represent student interest at faculty meetings

Scholarships & Awards

2023 Vanier Canadian Graduate Scholarship ($150,000 value)
2022 UNIQUE Neuro-AI Excellence Scholarship ($15,000 value)
2016 Class of 4T3 Engineering James Ham Award ($10,000 value)
2015 Class of 5T6 Award of Merit ($15,000 value)
2013 First Choice Science Award
2012 McGill Science Award and Scholarship
2012 A.J. Grant Shield and Scholarship
2012 Quebec English Public Speaking (Provincial Finals) — Bronze Medal
2012 Governor General of Canada Academic Medal
2012 Royal Bank of Canada Shield
2012 Davies Family Shield
2012 Eakeley Shield
2011 Quebec French Public Speaking (Provincial Finals) — Silver Medal