Nicole Sandra-Yaffa Dumont

Ph.D. Candidate

@ ns2dumont@uwaterloo.ca Waterloo, Canada linkedin.com/in/nicole-dumont
github.com/nsdumont compneuro.uwaterloo.ca/people/nicole-dumont.html orcid.org/0000-0001-5041-1527

Education

Ph.D in Computer Science

Sept 2019 – Expected 2025
Waterloo, Canada

University of Waterloo

- Research in computational neuroscience (specifically, spatial cognition and reinforcement learning) under the supervision of Chris Eliasmith, head of the Computational Neuroscience Research Group, and Jeff Orchard, head of the NeuroCognitive Computing Lab.
- Neuro-symbolic modelling for spatial representation and updating
  - Using grid cells to represent continuous features as Spatial Semantic Pointers (SSPs). A key feature of this approach is that SSPs can be bound with other features – both continuous and discrete – to create structured, hierarchical representations containing information from multiple domains (*e.g.*, spatial, temporal, visual, conceptual).
  - Spiking neural network models of path integration and SLAM using SSPs.
- Reinforcement learning (RL) and action selection
  - Developing biologically plausible, online learning rules for RL in continuous time settings using State Space Models
  - SSPs & successor features for navigation
  - SSPs in a Bayesian Optimization algorithm for efficient active exploration in multi-agent environments

Computational Mathematics (Masters of Mathematics – Co-op Program)

Sept 2017 – April 2019
Waterloo, Canada

University of Waterloo

- Robust optimization of an asset pricing model applied to carbon emissions.

Honours Mathematics and Physics (Bachelors of Science)

Sept 2012 – April 2017
Hamilton, Canada

McMaster University

Research

Publications & conferences

- **Dumont, N.S.**, Furlong, P. M., Orchard, J., & Eliasmith, C. (2023). Exploiting semantic information in a spiking neural slam system. *Frontiers in Neuroscience*, *17* [Link]
- **Dumont, N.S.**, Stöckel, A., Furlong, P. M., Bartlett, M., Eliasmith, C., & Stewart, T. C. (2023). Biologically-based computation: How neural details and dynamics are suited for implementing a variety of algorithms. *Brain Sciences*, *13*(2), 245 [Link]
- **Dumont, N.S.**, Orchard, J., & Eliasmith, C. (2022). A model of path integration that connects neural and symbolic representation. In *Proceedings of the annual meeting of the cognitive science society* (Vol. 44, *44*), Toronto, ON: Cognitive Science Society [Link]
- **Dumont, N.S.**, Stewart, T. C., & Eliasmith, C. (2021). Spiking neural network model of simultaneous localization and mapping with spatial semantic pointers. In *Computational and systems neuroscience (Cosyne) 2021*, Online [Link]
- **Dumont, N.S.**, & Eliasmith, C. (2020). Accurate representation for spatial cognition using grid cells. In *42nd annual meeting of the cognitive science society* (pp. 2367–2373). Toronto, Canada: Cognitive Science Society [Link]
- Furlong, P. M., Dumont, N., & Orchard, J. (2024). A recurrent dynamic model for efficient bayesian optimization. In *2024 neuro inspired computational elements conference (NICE)* (pp. 1–5). IEEE [Link]
- Furlong, P. M., Simone, K., **Dumont, N.S.**, Bartlett, M., Stewart, T. C., Orchard, J., & Eliasmith, C. (2024). Biologically-plausible markov chain monte carlo sampling from vector symbolic algebra-encoded distributions. In *International conference on artificial neural networks* (pp. 94–108). Springer [Link]
- Bartlett*, M., Simone*, K., **Dumont, N.S.***, Eliasmith, C., & Orchard, J. (3). Improving reinforcement learning with biologically motivated continuous state representations. In *International conference on cognitive modelling (ICCM) 2023*, Amsterdam, Netherlands [Link]
- Bartlett*, M., **Dumont, N.S.***, Furlong, M. P., & Stewart, T. C. (2022). Biologically-plausible memory for continuous time reinforcement learning. In *International conference on cognitive modelling (ICCM) 2022*, Toronto, Canada [Link]

- Coleman, T. F., **Dumont, N.S.**, Li, W., Liu, W., & Rubtsov, A. (2021). Optimal pricing of climate risk. *Computational Economics*, 1–34 [Link]
- Voelker, A. R., Blouw, P., Choo, X., **Dumont, N.S.**, Stewart, T. C., & Eliasmith, C. (2021). Simulating and predicting dynamical systems with spatial semantic pointers. *Neural Computation*, *33*(8), 2033–2067 [Link]

Teaching

- **CS 371: Introduction to Computational Mathematics (2022):** I was the sole instructor for two sections of course, teaching over 120 students. I prepared in-person lectures, video lectures, assignments, and tests covering a range of numerical methods. In the Student Course Perceptions survey, over 80% of students agreed that I helped them understand the course concepts and fostered a supportive learning environment.
- **CS 245: Logic and Computation (2019, 2020):** I was a graduate Teaching Assistant and Instructional Apprentice for this introductory course on mathematical logic. I prepared and led tutorials, graded assignments, and assisted students during office hours.

Academic service

- Co-organizer of the Language and Thought topic area at the 2024 Telluride Neuromorphic Cognition Engineering Workshop
- Volunteer and co-organizer for the Nengo summer school in 2023 and 2024
- Review Editor for Frontiers in Neuroscience

Scholarships & Awards

- European Neural Network Society (ENNS) Best Paper Award for "Biologically-plausible Markov Chain Monte Carlo Sampling from Vector Symbolic Algebra-encoded Distributions"
- Best New Neuromorph at the Telluride Neuromorphic Cognition Engineering Workshop (2024)
- Barbara Hayes-Roth Award for Women in Math and Computer Science (2022)
- Go-Bell Scholarship (2019, 2020)
- Provost Doctoral Entrance Award for Women (2019)
- Keith & Debbie Geddes Graduate Scholarship (2019)
- The Emanuel Williams Scholarship in Physics (2014)

Professional experience

Part-time Neuromorphic Scientist & Engineer

Applied Brain Research

Dec 2022 – Jan 2024
Waterloo, Canada

- Developed software to integrate a Spatial Semantic Pointer-based SLAM algorithm within a MuJoCo simulation environment and benchmarked it on neuromorphic hardware (Intel's Loihi 1 chip).

Research Associate

Cayuga Research

May 2018 – Aug 2019
Waterloo, Canada

- Consulting work focused on the development and implementation of optimization methods and data driven solutions to industrial problems.
- Projects included development of a global optimization toolbox in Matlab, prototype flight path optimization software, and chiller plant optimization & modelling.

Skills

Programming languages: Python, Matlab, and C++
Neural network and machine learning packages: PyTorch, Nengo, Nengo-Loihi