

# YUHAN HELENA LIU

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Citizenship: Canada

## EDUCATION

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PhD., Applied Mathematics, University of Washington (UW)	2024 (expected)
<i>Advisor:</i> Prof. Eric Shea-Brown	
MASc., Electrical and Computer Engineering, University of Toronto (U of T)	2019
BASc., Engineering Science (Electrical and Computer Option), U of T	2017

## VISITING RESEARCH POSITIONS

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Visiting researcher, MIT McGovern Institute	2023
Research intern, Mila – Quebec AI Institute	2021 - Present
Visiting scientist, Allen Institute for Brain Science	2020 - Present

## HONORS AND AWARDS

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Rising Stars in Computational and Data Sciences	2024
NSERC Postdoctoral Fellowship: <b>90000 CAD (declined)</b>	2024
Carl E. Pearson Fellowship: <b>TBD*</b>	2023 - 2024
FRQNT Doctoral Research Fellowship: <b>25000 CAD</b>	2023 - 2024
FRQNT Doctoral Research Fellowship Supplement: <b>1500 CAD**</b>	2023 - 2024
Weill Neurohub and NeuroTEC Travel Award: <b>500 USD</b>	2023
Mitacs Globalink Research Award: <b>6000 CAD</b>	2023
NeurIPS Scholar Award: <b>1748 USD</b>	2022
NSF AccelNet IN-BIC Exchange Fellowship: <b>10000 USD</b>	2022
Boeing Research Award: <b>500 USD</b>	2021
NSF AccelNet IN-BIC Exchange Fellowship: <b>8400 USD</b>	2021
NSERC Postgraduate Scholarship (PGS D3): <b>21000 CAD/year</b>	2020 - 2023
Queen Elizabeth II Graduate Scholarship: <b>15000 CAD</b>	2018 - 2019
Ontario Graduate Scholarship: <b>15000 CAD</b>	2017 - 2018
U of T Engineering Science Capstone Design Winner: <b>1500 CAD</b>	2017
U of T Engineering Society Award: <b>4200 CAD</b>	2015
NSERC Undergraduate Summer Research Award: <b>5600 CAD</b>	2014
U of T Club for Biomedical Engineering Competition Winner: <b>300 CAD</b>	2014
U of T Tetra Enable Competition Potential Award: <b>200 CAD</b>	2013

\*= Administered by the UW Applied Mathematics Department to fund the final year of PhD study. This distinct honor has only been awarded to three individuals in the department's history, including myself.

\*\*= Attributed to the ten eligible applications in the Québec province that received the highest ranking among all committees

## PEER-REVIEWED PUBLICATIONS

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**Liu, Y.H.**, Baratin A., Cornford J., Mihalas S., Shea-Brown E., Lajoie G., “How connectivity structure shapes rich and lazy learning in neural circuits”, International Conference on Learning Representations (ICLR), 2024 (accepted).

Ghosh A., **Liu Y.H.**, Lajoie G., Kording K., Richards B. A., “How gradient estimator variance and bias impact learning in neural networks”, ICLR, 2023.

**Liu Y.H.**, Ghosh A., Richards B. A., Shea-Brown E., Lajoie G., “Beyond accuracy: generalization properties of bio-plausible temporal credit assignment rules”, Advances in Neural Information Processing Systems (NeurIPS), 2022.

**Liu Y.H.**, Smith S.J., Mihalas S., Shea-Brown E., Sumbul U., “Biologically-plausible backpropagation through arbitrary timespans via local neuromodulators”, NeurIPS, 2022.

**Liu Y.H.**, Smith S.J., Mihalas S., Shea-Brown E., Sumbul U., “Cell-type-specific neuromodulation guides synaptic credit assignment in a spiking neural network”, Proceedings of the National Academy of Sciences (PNAS), 2021.

**Liu Y.**, Grigorovsky V., Bardakjian B., “Excitation and Inhibition Balance Underlying Epileptiform Activity,” Institute of Electrical and Electronics Engineers (IEEE) Transaction on Biomedical Engineering, 2020.

Jacobs D., **Liu Y.H.**, Hilton T., del Campo M., Carlen P.L., Bardakjian B.L., “Classification of Scalp EEG States Prior to Clinical Seizure Onset,” IEEE Journal of Translational Engineering in Health and Medicine, 2019.

**Liu Y.**, Khisti A., Mahajan A., “On privacy in smart metering systems with periodically time-varying input distribution,” Proceedings of IEEE Global Conference on Signal and Information Processing, 2017.

**Liu Y.H.**, Lee S-H., Khisti A., “Information-theoretic privacy in smart metering systems using cascaded rechargeable batteries,” IEEE Signal Processing Letters, 2017.

## PREPRINTS

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Hazelden J., **Liu, Y.H.**, Shlizerman E., Shea-Brown E., “Evolutionary algorithms as an alternative to backpropagation for supervised training of Biophysical Neural Networks and Neural ODEs”, arXiv, 2023.

**Liu, Y.H.**, Smith S.J., Mihalas S., Shea-Brown E., Sumbul U., “A solution to temporal credit assignment using cell-type-specific modulatory signals,” BioRxiv, 2021.

## INVITED TALKS

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*“Leveraging deep learning frameworks to probe learning and generalization in biological recurrent neural networks.”* Invited talk for the Kempner Institute at Harvard University (December 2023).

- "Leveraging deep learning frameworks to probe learning and generalization in biological recurrent neural networks."* Invited talk for the Neural Theory Group at the University of Oregon (November 2023).
- "Investigating learning and generalization in the brain using theoretical deep learning frameworks."* Invited talk for The Center for the Physics of Biological Function (CPBF) at Princeton University (November 2023).
- "Deep learning frameworks to probe learning and generalization in biological recurrent neural networks."* Invited talk for the MIT McGovern Institute (October 2023).
- "Deep learning frameworks to probe learning and generalization in biological recurrent neural networks."* Invited talk for the Grossman Center at the University of Chicago (October 2023).
- "Deep learning frameworks to probe learning and generalization in biological recurrent neural networks."* Invited talk for the Pillow Lab at Princeton University (October 2023).
- "Beyond accuracy: generalization properties of bio-plausible temporal credit assignment rules."* Invited talk for the Mila – Quebec AI Institute NeuroAI reading group (October 2022).
- "Beyond accuracy: robustness and generalization properties of biologically plausible learning rules."* Invited talk for UW Neural Computation and Engineering Connection (May 2022).
- "Beyond accuracy: robustness and generalization properties of biologically plausible learning rules."* Invited talk for International Network for Bio-Inspired Computing (April 2022).
- "A solution to temporal credit assignment using cell-type-specific modulatory signals."* Invited talk for Lajoie Group meeting at Mila – Quebec AI Institute (September 2021).
- "A solution to temporal credit assignment using cell-type-specific modulatory signals."* Invited talk for the Credit Assignment and Brain Workshop at the Allen Institute (August 2021).

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#### ACCEPTED ORAL ABSTRACTS

- Liu, Y.H.,** Baratin A., Cornford J., Mihalas S., Shea-Brown E., Lajoie G., "How connectivity structure shapes rich and lazy learning in neural circuits", NeuroAI Montreal, 2023.
- Liu, Y.H.,** Smith S.J., Mihalas S., Shea-Brown E., Sumbul U., "Biologically-plausible backpropagation through arbitrary timespans via local neuromodulators," Computational and Systems Neuroscience (COSYNE), 2023.
- Liu, Y.H.,** Ghosh A., Shea-Brown E., Lajoie G., "Beyond accuracy: robustness and generalization properties of biologically plausible learning rules," From Neuroscience to Artificially Intelligent Systems (NAISys), 2022.
- Liu, Y.H.,** "A Large-Scale Neuro-Glial Network Model of Seizure Termination," U of T Annual Research Conference, 2019.

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#### ACCEPTED POSTER ABSTRACTS

- Liu, Y.H.,** Baratin A., Cornford J., Mihalas S., Shea-Brown E., Lajoie G., "How connectivity structure shapes rich and lazy learning in neural circuits", COSYNE, 2022.
- Liu, Y.H.,** Baratin A., Cornford J., Mihalas S., Shea-Brown E., Lajoie G., "How recurrent network connectivity shapes learning: implications for effective rich and lazy regimes in neuroscience", Lake Conference – Neural Coding and Dynamics, 2023.

- Liu Y.H.**, Ghosh A., Richards B. A., Shea-Brown E., Lajoie G., “Beyond accuracy: generalization properties of bio-plausible temporal credit assignment rules”, 9th Annual BRAIN Initiative Meeting, 2023.
- Liu, Y.H.**, Smith S.J., Mihalas S., Shea-Brown E., Sumbul U., “Biologically-plausible backpropagation through arbitrary timespans via local neuromodulators,” NeuroAI in Seattle, 2022.
- Liu, Y.H.**, Lajoie G., “Beyond accuracy: robustness and generalization properties of biologically plausible learning rules,” COSYNE, 2022.
- Liu, Y.H.**, Smith S.J., Mihalas S., Shea-Brown E., Sumbul U., “A solution to temporal credit assignment using cell-type-specific modulatory signals,” COSYNE, 2021.

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## TEACHING AND MENTORING EXPERIENCES

### Research Mentoring

- Weixuan Liu, Computer Science Undergrad 04/2023 – present
- Rita Zhang, Mathematics Undergrad 04/2023 – present
- Hanson Mo, Physics Undergrad 10/2023 – present

### Instructor of Record

- Introduction to Neural Coding and Computation, UW 01/2024 – present
- Applied Linear Algebra and Numerical Analysis, UW 06/2022 – 08/2022

### Guest Lecturer

- Mathematical Biology, Whitworth University 01/2024

### Teaching Assistant

- COSYNE Tutorial on Spiking Neural Networks 03/2022
- Calculus with Analytic Geometry, UW 09/2019 – 12/2020
- Fundamentals of Computer Programming, U of T 01/2019 – 04/2019
- Linear Algebra, U of T 09/2018 – 12/2018
- Calculus III, U of T 09/2018 – 12/2018
- Introduction to Computer Programming, U of T 09/2017 – 12/2017

**Course Design Assistant\***, Neuromatch Academy 04/2023 – present

\* Designed teaching tools based on large language models (LLMs) to provide expanded explanations on course material and to guide students through coding exercises

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## SERVICE AND OUTREACH

- Co-organizer**, COSYNE 2024 Workshop 01/2024 - present
- Reviewer**, COSYNE 2024 12/2023
- Secretary**, UW Association for Women in Mathematics 09/2023 - present
- Reviewer**, NeurIPS 2023 06/2023 – 08/2023
- Session Chair**, UW Neural Computation and Engineering Connection 05/2023
- Outreach Volunteer**, SIAM Math Fair at Lockwood Elementary School 05/2023
- Reviewer**, COSYNE 2023 12/2022
- Panelist**, UW SIAM Student Chapter 10/2020 – present
- Student Organizer**, Joint Group Meeting, Fairhall and Shea-Brown Groups 01/2022 – 06/2022

<b>Student Organizer</b> , UW Theoretical Neuroscience Journal Club	09/2020 – 06/2021
<b>Mentor</b> , UW Amath Student Mentorship Program	07/2020 – 06/2022
<b>Event Director</b> , U of T IEEE Student Chapter	09/2016 – 04/2017
<b>Co-Chair</b> , U of T Engineering Science Education Conference	03/2015 – 02/2016
<b>Programming Director</b> , U of T Undergraduate Engineering Research Day	05/2014 – 08/2014

## ADDITIONAL TRAINING

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<i>Summer Workshop on the Dynamic Brain</i> , Allen Institute for Brain Science	08/2021
<i>Scientific Writing</i> , Faculty of Applied Science and Engineering, U of T	01/2019 – 04/2019

## TECHNICAL SKILLS

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Strong proficiency in Python (NumPy, Matplotlib, TensorFlow, PyTorch), MATLAB, C/C++, shell scripting and working with supercomputers.

## BLOG WRITING

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*“Generalization properties of bio-plausible temporal credit assignment rules.”* The Mila Blog (June 2023), URL: <https://tinyurl.com/4hz6uvs9>

## SOFTWARE

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**Research code** (<https://github.com/Helena-Yuhan-Liu?tab=repositories>)

Repositories with code to generate figures and experiments from my papers