

# YUHAN HELENA LIU

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Citizenship: Canada

## EDUCATION

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Postdoctoral Training, Princeton University	2024 - present
<i>Advisor:</i> Prof. Jonathan Pillow	
PhD., Applied Mathematics, University of Washington (UW)	2024
<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

## RESEARCH POSITIONS

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Postdoctoral research associate, Princeton Neuroscience Institute (PNI) & Center for Statistics and Machine Learning (CSML), Princeton University	2024 – present
Graduate research fellow, University of Washington	2020 – 2024
Visiting researcher, MIT McGovern Institute	2023
Research intern, Mila – Quebec AI Institute	2021 - 2023
Visiting scientist, Allen Institute for Brain Science	2020 - 2023

## HONORS AND AWARDS

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Rising Stars in EECS, MIT	2024
Boeing Teaching Award: <b>300 USD</b>	2024
FRQNT Postdoctoral Research Fellowship: <b>90000 CAD (ranked 1<sup>st</sup>)</b>	2024 - 2026
Rising Stars in Computational and Data Sciences, UT Austin	2024
IVADO Postdoctoral Fellowship: <b>210000 CAD (offered, but declined)</b>	2024
NSERC Postdoctoral Fellowship: <b>90000 CAD (offered, but declined)</b>	2024
Carl E. Pearson Fellowship: <b>37000 USD*</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>63000 CAD</b>	2020 - 2023
Queen Elizabeth II Graduate Scholarship: <b>15000 CAD</b>	2018 - 2019

Ontario Graduate Scholarship: <b>15000 CAD</b>	2017 - 2018
Engineering Science Capstone Design Winner, U of T: <b>1500 CAD</b>	2017
Engineering Society Award, U of T: <b>4200 CAD</b>	2015
NSERC Undergraduate Summer Research Award: <b>5600 CAD</b>	2014
Club for Biomedical Engineering Competition Winner, U of T: <b>300 CAD</b>	2014
Tetra Enable Competition Potential Award, U of T: <b>200 CAD</b>	2013

Total amount obtained: about 280,000 CAD

\*= Administered by the UW Applied Mathematics Department and has been awarded to only three individuals in the department's history, including myself, at the NSF GRFP rate (adjusted based on the FRQNT support)

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

## SELECTED 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.
- 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.

## FULL PEER-REVIEWED PUBLICATIONS LIST

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- Liu W., Zhang X., **Liu, Y.H.**, "The Influence of Initial Connectivity on Biologically Plausible Learning", AI to Accelerate Science and Engineering at the Association for the Advancement of Artificial Intelligence (AAAI), 2025.
- Liu Y.H.**, Yang R.G., Cueva C.J., "Multiple temporal credit assignment rules achieve comparable neural data similarity", NeuroAI at NeurIPS, 2024.
- 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.
- 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.

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## PREPRINTS

- Ghosh M., Habashy K.G., De Santis F., Fiers T., ..., **Liu, Y.H.**, ..., Goodman F., “Spiking neural network models of sound localisation via a massively collaborative process”, bioRxiv, 2024.
- Mastrovito D., **Liu, Y.H.**, Kusmierz L., Shea-Brown E., Koch C., Mihalas S., “Transition to chaos separates learning regimes and relates to measure of consciousness in recurrent neural networks”, bioRxiv, 2024.
- 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.

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## TEACHING AND MENTORING EXPERIENCES

### Instructor of Record

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|---|-------------------|
| • Introduction to Neural Coding and Computation, UW | 01/2024 – 03/2024 |
| • Applied Linear Algebra and Numerical Analysis, UW | 06/2022 – 08/2022 |

### Research Mentoring

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

<b>Course Design Assistant**</b> , Neuromatch Academy	04/2023 – 07/2023
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### Guest Lecturer

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| • Mathematical Biology, Whitworth University | 01/2024 |
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### Teaching Assistant

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| • 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 |

\* Each of my three mentees is preparing their first-authored manuscript under my supervision.

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

## INVITED TALKS

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Center for Statistics and Machine Learning at Princeton University	12/2024
Kempner Institute at Harvard University	12/2023
Neural Theory Group at the University of Oregon	11/2023
The Center for the Physics of Biological Function at Princeton University	11/2023
MetaConscious Group at MIT McGovern Institute	10/2023
Grossman Center at the University of Chicago	10/2023
Pillow Lab at Princeton University	10/2023
NeuralAI reading group at Mila – Quebec AI Institute	10/2022
UW Neural Computation and Engineering Connection	05/2022
International Network for Bio-Inspired Computing	04/2022
Lajoie Group at Mila – Quebec AI Institute	09/2021
Summer Workshop on the Dynamic Brain at the Allen Institute	08/2021

## ACCEPTED ORAL PRESENTATIONS

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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”, 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.

## ACCEPTED POSTER PRESENTATIONS

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Mo H. H., **Liu Y.H.**, Shea-Brown E., Mihalas S., “How spiking vs rate dynamics in neural networks impact rich vs lazy learning regimes”, 10th Annual BRAIN Initiative Meeting, 2024.

**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, 2024.

**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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## SERVICE AND OUTREACH

<b>Reviewer</b> , COSYNE 2025 (reviewed 10 submissions)	11/2024
<b>Reviewer</b> , ICLR 2024 (reviewed 3 submissions)	10/2024 – 12/2024
<b>Co-organizer</b> , COSYNE 2024 Workshop	01/2024 – 03/2024
<b>Reviewer</b> , COSYNE 2024 (reviewed 10 submissions)	12/2023
<b>Secretary</b> , UW Association for Women in Mathematics	09/2023 – 05/2024
<b>Reviewer</b> , NeurIPS 2023 (reviewed 6 submissions)	06/2023 – 08/2023
<b>Session Chair</b> , UW Neural Computation and Engineering Connection	05/2023
<b>Outreach Volunteer</b> , SIAM Math Fair at Lockwood Elementary School	05/2023
<b>Reviewer</b> , COSYNE 2023 (reviewed 12 submissions)	12/2022
<b>Panelist</b> , UW SIAM Student Chapter	10/2020 – 12/2023
<b>Student Organizer</b> , Fairhall and Shea-Brown Joint Lab Meetings	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

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## NEWS COVERAGE

"Complex Wiring in Neural Networks," College of Arts and Sciences, University of Washington, December 2021. Available at: <https://tinyurl.com/mr36cvjz>

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## BLOG WRITING

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

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## ADDITIONAL TRAINING

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

## TECHNICAL SKILLS

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

## 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

Last updated: December 12<sup>th</sup>, 2024