

# LINGHAI LIU

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## EDUCATION

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### Brown University

To be completed: May 2023

B.S. in Applied Mathematics - Computer Science

B.A. in Mathematics

Overall GPA: 4.0/4.0

## SELECTED RESEARCH EXPERIENCES

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### Topological Representations for Neural Networks

May 2022 - Present

Advisor: Stuart Geman

Brown University

- Implement generative models capable of learning a richer collection of relationships using a hierarchy of idealized neurons. Their topological structures can be perturbed and potentially represent relationships.
- Design and use suitable objective (loss) functions and nonlinear mappings (layers) for existing neural networks and observe neural collapse effects over layers.

### Jacobian-free Backpropagation in Inverse Problems

May 2022 - July 2022

Advisor: Samy Wu Fung

REU Researcher, Emory University

- Compare classical optimization, standard feed-forward networks (Denoising CNN), Deep Unrolling methods, and implicit deep learning with applications to inverse problems in imaging.
- Train implicit networks to denoise images using Jacobian-free Backpropagation with fixed memory costs, which yield comparable results with current models.
- Attend midterm and poster presentation. Give a seminar on GPU usage.

### Noise Correlations for Task Learning

January 2021 - August 2021

Advisor: Matthew Nassar

Brown University

- Explored biologically plausible approaches to generate beneficial noise correlations, i.e. passing back information from the decision layer, that make learning a discrimination task faster and more robust.

## TEACHING & MENTORING

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### Teaching Assistant at Brown University

- APMA1690: Computational Probability & Statistics (TA) Fall 2022
- APMA1740/2610\*: Recent Applications in Probability & Statistics (TA) Spring 2022
- DATA1010\*: Probability, Statistics and Machine Learning (TA) Fall 2021
- CSCI1470/2470\*: Deep Learning (Head TA) Fall 2021
- APMA1650: Statistical Inference I (TA) Spring 2021

\* Courses at graduate level

### Peer Advisor, Meiklejohn Peer Advising Program

Fall 2020 - Spring 2021

- Together with a faculty member, advised 5 freshmen on academic and career development, and provided them with mental guidance and support.

## AWARDS & HONORS

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| Second place, Henry Parker Manning Mathematical Prizes, Brown University       | 2022 |
| Undergraduate Teaching & Research Awards, Brown University                     | 2021 |
| Second place (tied), Hartshorn-Hypatia Freshman Math Contest, Brown University | 2019 |

## TECHNICAL STRENGTHS

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### Computer Languages Languages

Python, Matlab, R,  $\text{\LaTeX}$ , Stata, Java, C  
English, Mandarin, French