Richard Lim

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Summary

Primary interests in the geometry of representation and generalization, and in neural algorithmic reasoning. Recent work includes proofs of structural limits on length generalization for dynamic programs using tropical and polyhedral geometry (NeurReps 2026), and a geometric minibatch sampling method for studying how data locality shapes optimization.

Education

May 2027 **Bowdoin College**, Brunswick, ME GPA: 4.0/4.0
Bachelor of Arts, Computer Science and Mathematics
Relevant Coursework: Intro Analysis; Topology; Computational Complexity; Multivariable Calculus; Linear Algebra; Artificial Intelligence; Combinatorics and Graph Theory; Advanced Analysis (measure theory and stochastic calculus; upcoming Spring 2027); Advanced Algebra (representation, quiver, and module theory; upcoming Spring 2027)

Spring 2026 **Eötvös Loránd University (ELTE)**, Budapest, HU With Honors (Kitüntetéssel)
Budapest Semesters in Mathematics
Relevant Coursework: Functional Analysis; Discrete and Convex Geometry; Quantum Logic and Probability (incl. spectral theory and tensor products)

Research Experience

Tropical (Min-Plus) Geometry of Length Generalization June 2026 - August 2026
Visiting Researcher, Naval Postgraduate School, Monterey, CA
Advisor(s): Dr. Ruriko Yoshida

- Proved a structure theorem identifying graph, tropical polynomial, and polyhedral representations of dynamic programs as isomorphic semirings, with a canonical form that makes equivalence decidable.
- Proved impossibility results limiting how algebra-native mechanisms alone induce length generalization.
- Built BrainSpace, a PCA-based tool for visualizing OOD generalization in hidden state space.
- Lead author on the manuscript for NeurReps 2026.

Clustered Mini-batching and Sampling for SGD August 2025 - May 2026
Visiting Researcher, HUN-REN SZTAKI AI Lab, Budapest, HU
Advanced Independent Study, Bowdoin College
Advisor(s): Dr. Jeová Farias Sales Rocha Neto, Dr. Bálint Zoltán Daróczy, Dr. András Benczúr

- Proposed and developed k-Neighborhood Aware Sampling (k-NAS), a minibatch sampler with a temperature that interpolates continuously between local and uniform sampling.
- Designed a controlled study isolating the effect of batch locality on optimization and generalization; preliminary results suggest gains over uniform sampling on reconstructing noisy images.
- Leading the manuscript (in preparation).

Sign2vec: An Expressive Embedding Space for ASL May 2025 - October 2025
Bowdoin Research Fellow, Bowdoin College
Advisor(s): Dr. Jeová Farias Sales Rocha Neto

– Trained and evaluated graph neural networks (GNNs) on >30,000 videos using PyTorch and High Performance Computing, conducting experiments to optimize model performance.

Group Differences in Lexical Search and Retrieval May 2024 - November 2024
Gibbons Research Fellow, Lexicon Lab, Bowdoin College
Advisor(s): Dr. Abhilasha A. Kumar

– Modeled clustering in lexical retrieval on a semantic fluency dataset of >500 participants using word emebeddings; wrote E-Prime program for follow-up electroencephalographic (EEG) experiments.

Publications

Lim, **Richard F. M.** and Ruriko Yoshida (2026). *On the Representational Geometry of Dynamic Programs*. arXiv: 2608.25034 [cs.LG]. URL: https://arxiv.org/abs/2608.25034. Accepted at NeurReps 2026, Extended Abstracts Track.

Talks and Presentations

Invited Talks

Lim, **Richard F. M.** (July 2026). "Learning Algorithms, Not Answers: A Framework for Length-OOD Generalization on Dynamic Programming Problems". Workshop in Operations Research/Systems Analysis. Guest lecture. Monterey, CA. Invited by Dr. Ruriko Yoshida.

Lim, **Richard F. M.** (May 2026). "k-Neighborhood Aware Sampling (k-NAS) for manifold-aware learning". HUN-REN AI Symposium. Jointly organized with Nanyang Technological University, Singapore. Budapest, HU. Invited by Dr. András Benczúr.

Lim, **Richard F. M.** (Mar. 2026). "Clustered Mini-batching and Sampling for Stochastic Neural Network Optimization". Seminar on the Manifolds in Machine Learning. Budapest, HU. Invited by Dr. András Benczúr and Dr. Bálint Zoltán Daróczy.

Poster Presentations

Lim, **Richard F. M.** and Ruriko Yoshida (Aug. 2026). "Teaching Algorithms to Machines". Summer Internship Poster Session. Monterey, CA.

Lim, **Richard F. M.** and Jeová Farias Sales Rocha Neto (Oct. 2025). "Toward an Expressive Semantic Map for Sign Language Processing". President's Summer Research Symposium. Brunswick, ME.

Lim, **Richard F. M.**, Amanda Cooney, Channing Hambric, and Abhilasha A. Kumar (Nov. 2024). "Group Differences in Lexical Source Use and Clustering During Memory Search". Psychonomic Society 65th Annual Meeting. New York, NY.

Lim, **Richard F. M.** and Abhilasha A. Kumar (Oct. 2024). "CompCog: Modeling Search Within the Mental Lexicon". President's Summer Research Symposium. Brunswick, ME.

Grants and Funding

CXD Funded Internship Grant $7000, June 2026

Awarded for the study of Tropical methods for machine learning with Dr. Ruriko Yoshida at the Naval Postgraduate School in Monterey, CA

Bowdoin Research Award $5520, May 2025

Awarded for the study of NLP techniques for Sign Language understanding with Dr. Jeova Farias

Gibbons Summer Research Fellowship $5520, May 2024

Awarded for the study of lexical retrieval using computational models with Dr. Abhilasha Kumar

Academic Honors

Book Award (4.0 Yearly GPA) 2024, 2025
Sarah and James Bowdoin Scholar (Dean's List; top 20% Yearly GPA) 2024, 2025

Teaching Experience

Teaching Assistantships
Departments of Mathematics and Computer Science, Bowdoin College

Algorithms	Fall 2025, Fall 2026
Intermediate Integral Calculus	Fall 2024
Multivariable Calculus	Fall 2025
Linear Algebra	Spring 2025
Intermediate Linear Algebra	Fall 2026
Quantum Computing	Fall 2026

Quantitative Tutor Fall 2024 - Present
Baldwin Center for Learning and Teaching, Bowdoin College
Tutored students in a range of Mathematics and Computer Science classes

Leadership and Service

Reviewer 2026
NeurIPS 2026 Workshop on Symmetry and Geometry in Neural Representations

Student Advisor for the Tenure-Track Faculty Search 2024 - 2025
Department of Computer Science, Bowdoin College

Captain, Bowdoin Quiz Bowl Fall 2025, Fall 2026 - Present
Managed club budget and led a team of 15 members in weekly practice and intercollegiate tournaments

Resident Assistant Fall 2024 - Spring 2025
Office of Residential Life, Bowdoin College
– Led orientation and community-building activities for 120 first-year and upper class residents; resolved conflicts and provided social and emotional support to a floor community of 16

Ammunition Technician January 2021 - November 2022
Singapore Armed Forces
– Planned duty schedules and food rations for the ammunition depot staff of 80
– Developed and executed orientation, and safety and security training programs for posted-in soldiers
– Awarded Best Soldier of the Month and Letter of Commendation from the Battalion CO