Herlock Rahimi

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Education

Ph.D., Electrical & Computer Engineering — Yale University
Advisors: Dionysis Kalogerias, Amin Karbasi
M.Sc., Electrical & Computer Engineering — Yale University
B.Sc., Mathematics and Applications — Sharif University of Technology-GPA: 19.34/20
B.Sc., Computer Engineering — Sharif University of Technology - GPA: 19.01/20
Iran National Summer Camp for Mathematics Olympiad | **Silver Medalist**

Research Interests

Theoretical Foundations

Spectral Calculus of Operators | Markov Semigroups and Dynamical Systems | Robust, Risk-Sensitive & Distributionally-Aware Optimization | Geometric & Statistical Machine Learning |

Applications

Federated Learning | Private & Decentralized Machine Learning | Fair Diffusion Models | Risk-Averse Optimization | Reasoning & Generalization in Large Language Models

Publications & Preprints

- **Rahimi, H.**, Kalogerias, D. (2025). *Convergence of Agnostic Federated Averaging*. In **Proc. IEEE CAMSAP 2025** — Student Paper Contest Finalist (Top 5). doi:10.48550/arXiv.2507.10325. *Contribution:* Provided the first rigorous convergence proof of *Agnostic FedAvg* under random, non-uniform client availability. Established convex convergence at rate $\mathcal{O}(1/\sqrt{T})$ without assuming known participation distributions, bridging theoretical and practical FL deployment regimes.
- **Rahimi, H.**, Kalogerias, D. (2025). *FedAVOT: Exact Distribution Alignment in Federated Learning via Masked Optimal Transport*. **ICASSP 2026 (to appear)**; arXiv:2509.14444 [cs.LG]. doi:10.48550/arXiv.2509.14444. *Contribution:* Formulated federated aggregation as a masked optimal transport alignment between availability and importance distributions. Developed a Sinkhorn-based transport weighting scheme achieving $\mathcal{O}(1/\sqrt{T})$ convergence and enhanced robustness across heterogeneous, fairness-sensitive, and low-availability regimes.
- Amirhossein Zare, Amirhessam Zare, Parmida Sadat Pezeshki, **Rahimi, H.**, Ali Ebrahimi, Ignacio Vázquez-García, Leo Anthony Celi (2025). *Uncertainty-Aware Generative Oversampling Using an Entropy-Guided Conditional Variational Autoencoder (LEO-CVAE)*. arXiv:2509.25334 [cs.LG]. doi:10.48550/arXiv.2509.25334. *Contribution:* Introduced a local-entropy weighted loss and uncertainty-guided sampling strategy for CVAEs to address class imbalance in high-dimensional biomedical data. Demonstrated superior generalization on ADNI and TCGA datasets compared to traditional and generative oversampling baselines.

Selected Research Experience

Reasoning for LLMs — Yale University (with Amin Karbasi & Zhouran Yang)
Investigating formal models of reasoning in large language models through chain-of-thought reliability, search-augmented inference, and curriculum-based alignment. Developing evaluation protocols for structured reasoning and compositional generalization.

Risk-Averse Federated Learning — Yale University (with Dionysis Kalogerias)
Designed and analyzed availability-aware FL algorithms under coherent and distributionally robust risk measures. Established finite-time convergence bounds; implemented PyTorch and `cvxpy` simulations on heterogeneous federated environments.

Supersymmetry in Machine Learning (B.Sc. Thesis) — Sharif University of Technology (with M. H. Rohban)
Explored symmetry-invariant formulations in representation learning inspired by supersymmetric transformations;

investigated analogies between Lagrangian mechanics and optimization dynamics in neural networks.

Attention-RL for Visual Question Answering — Sharif University of Technology (with H. Rabiee)

Developed patch-based attention reinforcement learning agents for multimodal reasoning in VQA; introduced attention-guided exploration policy to improve grounding and compositionality.

Histopathology Classification & Explainability via GNNs — Sharif University of Technology (with M. H. Rohban)

Applied geometric deep learning and risk-aware optimization to cancer detection; integrated adversarial robustness and explainability constraints within graph neural architectures.

Teaching Experience

Instructor, Information Geometry — Yale University

Designed and taught a graduate-level mini-course on the differential-geometric foundations of statistical learning, divergence minimization, and dual connections. Materials available at Course Website.

Instructor, Machine Learning — Sharif University of Technology (Online)

Developed and delivered a comprehensive introductory ML course (theory and applications) for 100+ students. Recorded lectures available at: YouTube.

Teaching Assistance,**S&DS 6690: Statistical Learning Theory** — Yale University

Teaching Assistance,**S&DS 317/517: Applied Machine Learning and Causal Inference** — Yale University

Teaching Assistance,**CPSC 483/683: Deep Learning on Graph-Structured Data** — Yale University — Course website

Teaching Assistant, Sharif University of Technology

Assisted instruction in multiple undergraduate and graduate-level courses across machine learning, optimization, and applied mathematics, including: *Machine Learning Theory (Spring 2023)*, *High-Dimensional Probability (Spring 2022)*, *Artificial Intelligence (Head TA, Spring 2022)*, *Compiler Design*, *Game Theory*, *Design of Algorithms*, *Linear Algebra*, *Bioinformatics*, and *General Mathematics I* (2020 – 2021).

Honors & Awards

- **Graduate Top-up Fellowship**, Yale University (2023, 2024) — $2,500 award recognizing top graduate performance among all graduate students.
- **Top 10 % Graduate**, Mathematics & Computer Engineering, Sharif University of Technology (2023).
- **Top-3 Finalist**, Iranian National Mathematics Olympiad for College Students (2022).
- **Top-3 Finalist**, Iranian National Statistics Olympiad for College Students (2021).
- **Rank 9**, Iranian National Math & Physics University Entrance Exam (2018) — nationwide.
- **Silver Medal**, Iranian National Mathematics Olympiad (2017).

Professional Experience

Research Intern, AI Med — Tehran, Iran

Developed and evaluated deep learning models for breast cancer detection from histopathology images; implemented attention-based CNN classifiers with explainability metrics for real data from Imam Khomeini Hospital.

Mathematics & Informatics Olympiad Instructor, Irysc Co. — Tehran, Iran

Taught combinatorics, graph theory, geometry, and number theory; designed competition problems and coached national teams.