

Ali Backour

✉ abackour@mit.edu |
 [LinkedIn](#)

Education

Massachusetts Institute of Technology (MIT)

GPA: 5.0/5.0

B.S. in Computer Science and Engineering (6-3); B.S. in Mathematics (18)

Sept 2022- May 2026

Master of Engineering in Computer Science

Sept 2026- May 2027

Relevant Courses: Inference and Information, Grad ML, NLP, RL, Advances in CV, Algorithm Design, Cryptography, Advanced Complexity Theory, Probabilistic method in Combinatorics, Fundamentals of Statistics, Seminar in Geometry

Teaching and Grading: Grader for Inference and Information (6.7800) and Theory of Computation (18.404).

Lab assistant for IntroML (6.3900) and Intro to Programming (6.1010).

Activities: Associate Advisor, Orientation Leader, Camp Kesem

Awards: International Mathematical Olympiad **IMO** 2020 — Silver Medalist

Experience & Leadership

Prelude Labs | NYC

6/2026 - 9/2026

Machin Learning Intern

- Investigate and prototype novel architectures and training paradigms for open-ended, multimodal generative models aimed at advancing computational creativity.
- Translate research ideas into scalable training and inference systems, bridging foundational modeling advances with production-grade deployment.

MIT CSAIL, Macinhe Learning and Inference Group | Cambridge, MA

01/2025 - Now

Research Assistant

- Developing information-theoretic methods based on dynamical independence to learn compact time-series representations and enable tokenization of high-dimensional unstructured data.
- Studying diffusion-based generative modeling of structured matrix manifolds under spectral and geometric constraints, and designing metrics to quantify generative creativity.
- Designed and evaluated a multi-scale CNN for turbulence super-resolution, achieving 4× upsampling of velocity fields

Genesis Therapeutics | Burlingame, CA

6/2025 - 9/2025

Software Engineering Intern

- Developed a decision engine for Kubernetes job retries, expanding pod failure observability coverage from 25% to 100% and reducing queued job times by ~10%.
- Improved system reliability by fixing GPU scheduling issues and implementing dynamic error handling.

MIT CSAIL, Theory of Computation Group | Cambridge, MA

6/2024 - 01/2025

Research Assistant

- Collaborated with Prof. Ryan Williams on proving new circuit lower bounds for complexity classes using randomized, time-bounded Kolmogorov complexity.
- Applied time-bounded Kolmogorov complexity to derive simplified proofs of existing circuit lower bound results.

Math Olympiad Training Initiative | Aleppo, Syria

06/2021 – Now

Founder and Lead Instructor

- Founded and led a training program that reached 300+ high school students, managing a team of 10+ instructors.
- Instructed the Syrian national team in competitive mathematics in preparation for international math Olympiads.

Projects and Publications

- **Mixing Is Not Meaning: Evaluating and Training LLMs for Soft-Token Reasoning:** Identified failure modes of soft-token reasoning in LLMs and proposed a training objective that improves mixture fidelity - **First author**.
- **Rotational Equivariance in Turbulent Flow Super-Resolution:** Demonstrated that CNNs can learn rotational equivariance in turbulence super-resolution, with errors depending on flow anisotropy and scale. [NeurIPS 2025, AI4PS]
- **RL for 2048 with Action Masking and Semi-Curriculum Learning:** Analyzed stationary-action failure modes in Value-based methods, trained DDQN/PPO agents achieving improved stability and performance in 2048 board game.
- **Encrypt What Matters: ROI-Guided FHE for CNN Inference:** Proposed a novel ROI-guided FHE for CNN inference, achieving order-of-magnitude speedups by encrypting only sensitive regions.