Borna Khodabandeh

Curriculum Vitae

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Google scholar
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Research Interests

- Mathematical foundations of machine learning and optimization
- Adversarial robustness and strategic behavior in learning systems
- Information theory and statistical learning
- Reinforcement learning and online decision-making
- Graph signal processing and graph neural networks
- Statistical physics in machine learning

Education

2026– **Stanford University**, *Ph.D. in Electrical Engineering*, Stanford, CA, USA.
Start Date: Fall 2026 (Deferred Admission)

2021–2025 **Sharif University of Technology**, *B.Sc. in Electrical Engineering, Minor in Physics*, Tehran, Iran.
Overall GPA: 19.65/20 Major GPA: 19.93/20

2021 Jan–Aug **International Physics Olympiad (IPhO) Training**, *Young Scholars Club*, Tehran, *IPhO*.
Selected among top 5 students in Iran to represent the national team; received a Silver Medal and was the highest-scoring participant from Iran.

Research experience

Summer 2024 **Summer Internship, E³ Program**, BIG | **EPFL** , Advised by Prof. Dr. Michael Unser .
Worked on the theoretical design of 1-Lipschitz-constrained (Parseval) convolutional operators and neural networks. These were applied to solve inverse problems and perform denoising, with proven theoretical bounds on stability and robustness. reducing parameters by introducing symmetry.

Study Sessions.
Conducted comprehensive literature reviews and study sessions on various subjects, including:
- Causality and bandit algorithms in collaboration with BAN at EPFL.
- Optimization on graphs and graph learning, learning weights from smooth signals on Erdos-Renyi graphs.
- Part of a research group, coordinating meetings and tracking project progress.

Publications

2025 **LORE: Lagrangian-Optimized Robust Embeddings for Visual Encoders**, *Borna Khodabandeh, Amirabbas Afzali, Amirhossein Afsharrad, Shahabeddin Mousavi, Sanjay Lall, Sajjad Amini, Seyed-Mohsen Moosavi-Dezfooli* , To appear at NeurIPS 2025 , ArXiv, Conducted as Bachelor's project .
Proposed an unsupervised adversarial fine-tuning approach based on constrained optimization to improve the robustness of visual encoders like CLIP, while maintaining clean accuracy. Demonstrated improved accuracy and enhanced resistance to adversarial attacks.

2024 **Optimizing Contrastive Learning models via Preference Optimization**, *Amirabbas Afzali, Borna khodabandeh, Ali Rasekh, Mahyar JafariNodeh, Sepehr Kazemi Ranjbar, Simon Gottschalk* , Published at ICLR , OpenReview ArXiv, Conducted at L3S Research center .
Developed a novel training paradigm for contrastive learning models, using policy optimization. This approach includes fine-tuning contrastive learning models such as CLIP based on human preferences to enhance performance and increase resilience against typical inductive biases and attacks.

2023 **Counter Histogram-Based Forensics using Mean Structural Similarity Index Metric**, *R. Kazemi, A. Amini, B. Khodabandeh and M. Alikhani* , to appear in SIAM J. Imaging Sci., 2025. , Voluntary.
Worked on the mathematical properties of the SSIM index, in a project focused on Counter Forensics(CF).

Awards

2021 **International Physics Olympiad (IPHO) Silver Medalist** *[verification]*
2020 **National Physics Olympiad Gold Medalist** *[verification]*
2024 **Top 3% Academic ranking (5/184)** *Sharif University of Technology*
2024 **E³ Fellowship program** *EPFL*

Course projects

2025 **Phase transitions in LoRA**, *High Dimentional Probability* , SUT, **source** .
Analyzed LoRA vs. full fine-tuning, explaining LoRA's peculiarities via Random Matrix Theory, specifically linking intruder dimensions to the Baik–Ben Arous–Péché (BBP) phase transition.

2024 **Information geometry**, *Information theory, statistics & learning project* , SUT, **source** .
Explored differential geometry and geometric approaches to statistical learning, including manifolds, divergences, and applications like Natural Gradient Descent.

2024 **Game theoric network design**, *Game theory project*, SUT, **source** .
Implementation of simulation models and protocols for game theoric network design, including stable matching, and optimal selling mechanisms, exploring their performance in network scenarios

2024 **GAN-BERT**, *Deep learning project*, SUT, **source**.
Implemented the GAN-BERT architecture, which adversarially trains a BERT-based generator against a discriminator to detect and classify LLM generated texts to the specific model used for generation.

Experience

Voluntary Teaching Experience

- Engineering Probability and Statistics
  Designing projects and problem sets
- Engineering Mathematics
  Holding Practice sessions
- Machine learning
  Designing problem sets and project
- Machine learning
  Head teaching assistant
- Linear Algebra
  Holding Practice sessions
- Signal processing
  Holding Practice sessions
- Deep learning
  Designing course project, practice sessions
- Convex Optimization
  Holding practice sessions

Relevant Coursework

the symbol "+" denotes graduate coursework

- Graph Signal Processing +
  (20.0/20.0)
- Game Theory +
  (20.0/20.0)
- Probability and Statistics
  (20.0/20.0)
- Signals and systems
  (20.0/20.0)
- High Dimentional Probability +
  20.0/20.0
- Graphical Models +
  Currently Enrolled
- Deep Learning +
  (19.70/20.0)
- Information theory, statistics & learning +
  (20.0/20.0)
- Linear Algebra
  (20.0/20.0)
- Convex optimization 1
  (20.0/20.0)
- Deep Generative Models +
  20.0

- Participant in the 24th ADFOCS (Max Planck), focused on Algorithmic Game Theory.

Miscellaneous

- Competitor in international math contests during Highschool, including WMTC 2016 (South korea, Seoul), IMC 2018 (Blagoevgrad, Bulgaria), and WMC 2018 (UK, Surrey).
- Physics Olympiad tutor at top high schools, training students for national competitions.

Skills

Technical: Advanced knowledge of mathematics: probability, stochastic calculus, differential equations, signal processing, information theory, machine learning

Machine Learning Tools: PyTorch, TensorFlow, OpenCV, scikit-learn, NumPy, pandas, matplotlib

Languages: Persian (native), English (advanced, Toefl-iBT: 113/120), French (Basic)

Misc: Problem-Solving, Collaboration, Communication, Teaching