Borna Khodabandeh

Curriculum Vitae

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Research Interests

- Theory of Optimization machine learning and mathematics of data science
- Game theory, Complex systems and Networks Science
- Information theory, statistics
- Reinforcement learning and Preference Optimization in deep networks
- Graph signal processing and Graph neural networks
- Statistical physics in learning

Education

2021–2025 **Sharif University of Technology | SUT**, *Bachelor's degree*, Tehran, Iran, .
Major in Electrical Engineering, Minor in physics
GPA – 19.65/20 - Major GPA – 19.93/20

Summer 2024 **École polytechnique fédérale de Lausanne (EPFL)**, *Lausanne*, Switzerland, .
Summer internship Advised by Prof. Dr. Michael Unser at Biomedical Imaging Group (BIG)

2021 Jan–Aug **International Physics Olympiad (IPHO) training**, *Young Scholars Club*, Tehran, *IPHO*.
As one of the top 5 students in Iran, I competed globally in the International Physics Olympiad Receiving the Silver medal, I received special training as a member of Iran's team.

2018–2021 **High school diploma**, *AE Highschool*, Tehran, *GPA – 19.69/20.00*.

Research experience

2024 **Optimizing Contrastive Learning models via Preference Optimization**, *Under peer-review for ICLR*, L3S Research center .
Developed a novel training paradigm for contrastive learning models, integrating policy optimization techniques. This approach includes fine-tuning models based on human preferences to enhance performance and increase resilience against typical inductive biases and adversarial attacks.

Summer 2024 **Summer Internship**, BIG | **EPFL** , Advised by Prof. Dr. Michael Unser .
Worked under the supervision of Prof. Dr. Michael Unser 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.

2023 **Counter Histogram-Based Forensics using Mean Structural Similarity Index Metric**, Multimedia lab | SUT , Advised by Dr. Arash Amini , Voluntary Research .
Worked on the mathematical properties of the SSIM index, in a project focused on Counter Forensics(CF), focused on the quasi-convexity of the index finding appropriate bounds.

Present **Small language models**, Multimedia lab | SUT , Advised by Dr. Arash Amini , Voluntary Research .
Working on designing task specific language models with limited parameter size.

Study Sessions.
Conducted comprehensive literature reviews and study sessions on various subjects, including:
- Causality and bandit algorithms in collaboration with BAN at EPFL.
- Coded computing, federated learning, and large-scale distributed learning.
- Optimization on graphs and graph learning, learning weights from smooth signals on Erdos-Renyi graphs.

Explored several research articles related to these topics.

Awards

2021 **International Physics Olympiad(IPHO) Silver Medalist** *[verification]*
2020 **National Physics Olympiad Gold Medalist** *[verification]*
2024 **Top 2% Academic ranking (4/185)** *Sharif University of Technology*
2024 **E^3 Program research completion Certificate** *EPFL*

Course projects

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.

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 **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.

Experience

Voluntary Teaching Experience

- Engineering Probability and Statistics
  Designing projects and problem sets
- Engineering Mathematics
  Holding Practice sessions
- Machine learning
  Designing problem sets
- Linear Algebra
  Holding Practice sessions
- Signal processing
  Holding Practice sessions
- Deep learning
  Designing course project

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 +
  Currently enroled
- 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 +
  Currently enroled
- Attended the 24th Max Planck Advanced Course on the Foundations of Computer Science (ADFOCS) on Algorithmic Game Theory
- Econophysics + (Auditing)

Miscellaneous

- Participated in various international mathematics competitions, including WMTC, IMC, and WMC during high school.
- Served as a Physics Olympiad tutor at top high schools and educational institutions, preparing students for national competitions.

Skills

Technical Skills

Programming: Python, Java, C/C++, GoLang, LaTeX

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

Soft Skills

Languages: Persian (native), English (advanced), French (Basic)

Misc: Problem-Solving, Collaboration, Communication, Teaching