

Motahareh Sohrabi

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Research Interests

- Deep Learning Theory
- Optimization
- Game Theory
- Generative Models
- AI Alignment

Education

University of Montreal/ Mila MSc (Thesis-based) in Computer Science Supervisor: Prof. Simon Lacoste-Julien	2021 - 2023
Sharif University of Technology BSc in Computer Engineering Supervisor: Prof. Mohammad Hossein Rohban	2016 - 2021

Publications

Weight-Sharing Regularization [link] Artificial Intelligence and Statistics (AISTATS 2024) Mehran Shakerinava*, <u>Motahareh Sohrabi*</u> , Siamak Ravanbakhsh, Simon Lacoste-Julien	2024
On PI controllers for updating Lagrange multipliers in constrained optimization International Conference on Machine Learning (ICML) <u>Motahareh Sohrabi*</u> , Juan Ramirez*, Tianyue Zhang, Simon Lacoste-Julien, Jose Gallego-Posada	2024

**equal contribution*

Research Experience

Present Sep 2021	Mila – Quebec Artificial Intelligence Institute <i>Graduate Research Assistant Supervisor: Prof. Simon Lacoste-Julien</i> <ul style="list-style-type: none">• Study of the Adaptive Step-size Optimization Algorithms for Min-Max Games• Focus: Min-max optimization, Constrained optimization, Theory of Deep learning
June 2021 Sep 2019	Robustness and Interpretability of Deep Learning Lab - Sharif University <i>Undergraduate Research Assistant Supervisor: Prof. Mohammad Hossein Rohban</i> <ul style="list-style-type: none">• Thesis: <i>Interpreting Vision Transformers by Random Walk on Attention Graph.</i>• Focus: Neural Network Interpretability, Adversarial Machine Learning.

Selected Research Projects

On PI controllers for updating Lagrange multipliers in constrained optimization	Apr 2023 - Feb 2024
<ul style="list-style-type: none">• To address the suboptimal dynamics of gradient descent in optimizing the Lagrangian of a constrained optimization problem, we introduce νPI algorithm for updating Lagrange multipliers and prove that it generalizes popular momentum methods.• Our experiments on SVMs and ResNet sparsity tasks demonstrate that νPI leads to improved stability and convergence. <i>Work under review for ICML 2024</i>	
Weight-Sharing Regularization [arxiv][code]	Jun 2023 - Oct 2023
<ul style="list-style-type: none">• We introduce weight-sharing regularization for neural networks. We propose a parallel algorithm with a depth of $O(\log^3 d)$ for computing the proximal mapping of our regularization term.• Experiments reveal that weight-sharing regularization enables fully-connected networks to learn convolution-like filters. Published at AISTATS 2024.	

Polyak Step-size for Adaptive Min-max Optimization Jul 2022 - May 2023

- We proposed the first adaptation of Polyak step-size for optimization of games.
- Empirically our method converges faster in strongly-convex games compared to non-adaptive methods. *Work in progress.*

Study of the Effect of Interaction of Players on the Convergence of Games Jan 2022 - Jul 2022

- We pinpointed the assumptions in the convergence analysis of games where the coupling objective term of players is ignored.
- Motivated by equilibrium of quadratic game and the second order condition of MINIMAX optimal point, we suggested utilizing the Shur complement as an alternative to current convergence proof assumptions. *Project for Theory of Deep Learning course.*

Predictive Uncertainty Estimation with Bayesian Neural Networks Sep 2021 - Jan 2022

- We employ Bayesian neural networks as a framework for assessing the uncertainty of deep neural networks.
- We explored STOCHASTIC GRADIENT LANGEVIN DYNAMICS and MC DROPOUT methods for sampling from the posterior and finding the distribution over the model’s output to measure uncertainty. *Project for Probabilistic Graphical Modeling course.*

Interpreting Vision Transformers by Random Walk on Attention Graph Sep 2020 - Jun 2021

- We interpret a vision transformer by performing random walk on the self-attention graph to capture the flow of information.
- We demonstrate that random walks converge to a unique stationary distribution of the MARKOV CHAIN, providing us with a heat map of the importance of each pixel. Our method yields promising results on IMAGENET trained with DEiT. *BSc thesis.*

Teaching Assistant

Theoretical Principles for Deep Learning (Graduate) (Prof. Ioannis Mitliagkas)	Winter 2023
Game Theory (Prof. MohammadAmin Fazli)	Fall 2020
Social and Economic Networks (Graduate) (Prof. MohammadAmin Fazli)	Fall 2019
Artificial Intelligence (Prof. Mohammad Hossein Rohban)	Spring 2019
Data Structure and Algorithm (Dr. Sharareh Alipour)	Fall 2018

Selected Graduate-level Courses

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|------------------------------------|--------------------------------|
| • Convex Optimization | • Theory of Deep Learning |
| • Probabilistic Graphical Modeling | • Adversarial Machine Learning |

Honors and Awards

2023-2022	Recipient of scholarship to attend summer schools : CIFAR Deep Learning Reinforcement Learning Summer School 2022, ProbAI 2023-Norway, MLSS in Science 2023-Poland.
2023	Recipient of the Excellence Scholarships–Women in AI from Mila.
2022	Recipient of scholarship under the Ministry of Higher Education’s of the University of Montreal.
2016-2020	Recipient of a yearly grant for outstanding academic success during undergraduate studies from the Iranian National Elites Foundation.
2016	Ranked 137th out of 160,000 applicants in Iran’s university entrance exam and getting admission to the country’s top technical university.

Services and Volunteer work

Organizer of a breakout session at the <i>WiML workshop</i> at ICML 2023, Hawaii.	2023-07
Co-founder of the <i>Mathematics Study Group</i> , weekly studies on topics such as analysis, algebra, topology, etc.	2023
Member of the <i>Office of Cultural Studies and Humanities</i> .	2018–2021
Member of the organizing team for the <i>Winter Seminar Series 2019</i> .	2019-01
President of the <i>Dormitory Student Association</i> .	2017–2019
Teacher for the <i>Complex Systems and Network Science</i> workshop for high-school students.	2018-08
Organizer of the <i>Complex Systems Journal Club</i> , weekly readings of “Social and Economic Networks”.	2018

Skills

Programming Languages	Python, C, Java, R, Bash	Frameworks/Libraries	PyTorch, Keras, WandB, Matplotlib
Other Tools	Git, SLURM, Linux	Languages	Persian (Native), English (Fluent)