

# Motahareh Sohrabi

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## Research Interests

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

## Education

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

## Publications

<b>Weight-Sharing Regularization</b> <a href="#">[link]</a> Artificial Intelligence and Statistics (AISTATS 2024) Mehran Shakerinava*, <u>Motahareh Sohrabi*</u> , Siamak Ravanbakhsh, Simon Lacoste-Julien <i>*equal contribution</i>	2024
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## Research Experience

Present Sep 2021	<b>Mila – Quebec Artificial Intelligence Institute</b> <i>Graduate Research Assistant   Supervisor: Prof. Simon Lacoste-Julien</i> <ul style="list-style-type: none"><li>• Study of the Adaptive Step-size Optimization Algorithms for Min-Max Games</li><li>• Focus: Min-max optimization, Constrained optimization, Theory of Deep learning</li></ul>
Summer 2021	<b>Shomara, a Data Analysis and Visualization Company</b> <i>Summer Intern</i> <ul style="list-style-type: none"><li>• Analysis of Customer Lifetime Value with Databricks solutions.</li><li>• Brief introduction on working with Spark, H2O, MLflow.</li></ul>
June 2021 Sep 2019	<b>Robustness and Interpretability of Deep Learning Lab - Sharif University</b> <i>Undergraduate Research Assistant   Supervisor: Prof. Mohammad Hossein Rohban</i> <ul style="list-style-type: none"><li>• Thesis: <i>Interpreting Vision Transformers by Random Walk on Attention Graph.</i></li><li>• Focus: Neural Network Interpretability, Adversarial Machine Learning.</li></ul>

## Selected Research Projects

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

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

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

## Honors and Awards

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

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