# Motahareh Sohrabi

motahareh.sohrabi@mila.quebec Google Scholar Website Github Linkedin

## Research Interests

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

## Education

**University of Montreal/ Mila** 2021 - 2023
MSc (Thesis-based) in Computer Science
Supervisor: Prof. Simon Lacoste-Julien

**Sharif University of Technology** 2016 - 2021
BSc in Computer Engineering
Supervisor: Prof. Mohammad Hossein Rohban

## Publications

**Weight-Sharing Regularization** [link] 2023
Artificial Intelligence and Statistics (AISTATS)
Mehran Shakerinava*, Motahareh Sohrabi*, Siamak Ravanbakhsh, Simon Lacoste-Julien

**equal contribution*

## Research Experience

Present – Sep 2021 **Mila – Quebec Artificial Intelligence Institute**
*Graduate Research Assistant* | *Supervisor: Prof. Simon Lacoste-Julien*
- Study of the Adaptive Step-size Optimization Algorithms for Min-Max Games
- Focus: Min-max optimization, Constrained optimization, Theory of Deep learning

Summer 2021 **Shomara, a Data Analysis and Visualization Company**
*Summer Intern*
- Analysis of Customer Lifetime Value with Databricks solutions.
- Brief introduction on working with Spark, H2O, MLflow.

June 2021 – Sep 2019 **Robustness and Interpretablity of Deep Learning Lab - Sharif University**
*Undergraduate Research Assistant* | *Supervisor: Prof. Mohammad Hossein Rohban*
- Thesis: *Interpreting Vision Transformers by Random Walk on Attention Graph.*
- Focus: Neural Network Interpretability, Adversarial Machine Learning.

## Selected Research Projects

**Weight-Sharing Regularization** [arxiv][code] Jun 2023 - Oct 2023

- 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 NNs to learn convolution-like filters. *AISTATS.*

**On PI controllers for updating Lagrange multipliers in constrained optimization** Apr 2023 - Oct 2023

- To address the suboptimal dynamics of gradient descent in optimizing the Lagrangian of a constrained optimization problem, we introduce $\nu$PI algorithm for updating Lagrange multipliers and prove that it generalizes popular momentum methods.
- Our experiments on SVMs and ResNet sparsity tasks demonstrate that $\nu$PI leads to improved stability and convergence. *Work under review for ICML 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

- Convex Optimization
- Probabilistic Graphical Modeling
- Theory of Deep Learning
- 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 *WiMl workshop* at ICML 2023, Hawaii. | 2023-07 |
| Co-founder of the *Mathematics Study Group*, weekly studies on topics such as analysis, algebra, topology, etc. | 2023 |
| Member of the *Office of Cultural Studies and Humanities.* | 2018–2021 |
| Member of the organizing team for the *Winter Seminar Series 2019*. | 2019-01 |
| President of the *Dormitory Student Association.* | 2017–2019 |
| Teacher for the *Complex Systems and Network Science* workshop for high-school students. | 2018-08 |
| Organizer of the *Complex Systems Journal Club*, 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) |