

# Sina Rezazadeh Baghal

AL & ML | Research Engineer

[LinkedIn](#) [Website](#) [Github](#)

Email: [siinabaghal@gmail.com](mailto:siinabaghal@gmail.com)

Phone: 226-972-8891, Toronto

## WORK EXPERIENCE

### TD (Data Scientist III)

Jul 23 - Present

#### Current position

Developed models to analyze customer behavior across the full banking portfolio to detect fraudulent activity. Supported stakeholders with ad-hoc requests by applying problem-solving and programming expertise.

**Tags:** Python PySpark SQL SAS Problem Solving Modeling Data Science

### CIBC (Quantitative Analyst)

Aug 22 - Jul 23

Developed Python packages and designed methodologies to meet risk management mandates. Implemented OOP with parallel processing to handle large datasets and leveraged bash scripting to ensure maintainability.

**Tags:** Mathematical Finance FRTB Python Performance Optimization Parallel Processing OOP

### Huawei Noah's Ark Lab (Machine Learning Researcher)

Feb 22 - Aug 22

Accelerated neural networks' SoftMax layer in PyTorch for both training and inference. Achieved baseline accuracy using only the optimal number of bits for classification, i.e.,  $\lceil \log_2 c \rceil$  where  $c$  is the number of classes.

**Tags:** Deep Learning Transformers Quantization Research Weight Distributions Pytorch

### University of Waterloo (Postdoc (CS), Grad (C&O))

May 16 - Feb 22

Conducted research in stochastic optimization and graph neural networks. Served as a teaching assistant for graduate and undergraduate courses.

**Tags:** Numerical Analysis Integer Programming Optimization Statistics Machine Learning Python CPU/GPU C++  
MATLAB Parallel Processing Dask Spark Code Performance Optimization OOP

### Young Scholars Club (Seasonal Mathematical Olympiad Coach (Iran))

Sep 06 - May 16

Taught courses in Advanced Mathematics. Led challenging problem-solving sessions (e.g., Putnam) to develop students' mathematical skills and contributed to the problem-design committee.

**Tags:** Problem Solving Mathematical Olympiad Problem Design

## DEVELOPMENT PROJECTS

### Solving Pasur Using GPU-Accelerated Counterfactual Regret Minimization ([arXiv Preprint](#))

Developed a CUDA-accelerated computational framework with optimized memory management to simulate a fishing card game, enabling the creation of an AI agent to play the game using Reinforcement Learning.

**Tags:** Reinforcement Learning Generative AI Artificial Intelligence Counterfactual Regret Minimization Efficient Computing  
PyTorch CUDA Game Theory GPU Optimization Memory Management Nash Equilibrium

### Generative Modeling of Heston Volatility Surfaces Via Variational Autoencoders ([Project Page](#), [Code](#))

Trained a Variational Autoencoder (VAE) on Heston stochastic volatility models to generate volatility surfaces for use in option pricing and financial applications.

**Tags:** Deep Learning Generative AI Variational Autoencoder PyTorch Heston Model Volatility Surfaces Vectorization  
Monte Carlo Simulation Numerical Analysis Optimization Option Pricing

### Implementing Deep Smoothing for Implied Volatility Surfaces ([Project Page](#), [Code](#))

Implemented in Python the methodologies from Deep Smoothing of the Implied Volatility Surface (Ackerer et al.), with independently developed approaches to neural network training, convergence, and implementation details.

**Tags:** Deep Learning Generative AI Feed Forward Networks PyTorch Volatility Surfaces Vectorization SSVI  
Convex Optimization CVX Fine-tuning Option Pricing

## EDUCATION

### University of Waterloo

May 16 - Apr 21

- PhD in Mathematical Optimization at the department of Combinatorics & Optimization

### Sharif University of Technology

Sep 06 - Jul 12

- Bachelor's and Master's degree in Fundamental Mathematics

## ACADEMIC PROJECTS

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- **Solution Manual to Stochastic Calculus for Finance II** ([Manuscript](#))

Authored a complete solution manual for Stochastic Calculus for Finance II, covering all exercises.

**Tags:** Mathematics Stochastic Calculus Option Pricing Finance Probability Theory

- **A Matrix Concentration Inequality for Products** ([arXiv Preprint](#))

Provided a non-asymptotic bound on the product of random positive semidefinite matrices, which can be used to analyze the convergence behavior of stochastic gradient descent in machine learning.

**Tags:** Mathematics High Dimensional Statistics Probability Theory

- **A Termination Criterion for Stochastic Gradient Descent for Binary Classification** ([arXiv Preprint](#))

Developed a computationally efficient early stopping criterion for machine learning, supported by theoretical guarantees, showing strong predictability on unseen data. Presented at the [NeurIPS](#) and the [Fields Institute](#).

**Tags:** Stochastic Gradient Descent Mixture of Gaussians Machine Learning Early Stopping Markov Chains Stochastic Stability

## SELECTED HONORS AND AWARDS

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International Scientific Olympiad in Mathematics (Silver Medal, 2010). Iranian Math. Olympiad (Silver Medal, 2005)<sup>1</sup>

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<sup>1</sup>Olympiad medals are awarded annually to 40 out of 320,000 competing students