Sina Rezazadeh Baghal

PhD in Mathematics (Optimization)

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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 | 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

- **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

International Scientific Olympiad in Mathematics (Silver Medal, 2010). Iranian Math. Olympiad (Silver Medal, 2005)[1]

[1] Olympiad medals are awarded annually to 40 out of 320,000 competing students