Mokhwa Lee

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LinkedIn | Moka's Website

Education

- **Stony Brook University** — Stony Brook, NY
  PhD candidate in Applied Mathematics and Statistics (AMS), Operations Research Track — *Aug. 2019 – Present*
  Advanced Certificate : Data and Computational Science
- **Ewha Womans University** — Seoul, Korea
  MS in Mathematics — *Mar. 2017 - Aug. 2019*
- **Ewha Womans University** — Seoul, Korea
  BS in Mathematics and Computational Science — *Mar. 2012 - Feb. 2017*

Programming Skills

- **Languages**: Python, MATLAB, R, (C, C++) **Technologies**: Github, API, LaTeX

Research

- **PhD in the OptiML Research Lab** — Stony Brook University, NY
  advisor : Yifan Sun (CS) and Joseph Mitchell (AMS) — *Oct. 2020 - Present*
  - **Advancing Multi-Secant Quasi-Newton Methods for Efficient Minimization of General Convex Functions**
    - Extended to a limited-memory version of the multisecant L-BFGS method to reduce computational overhead, enhancing its applicability to large-scale optimization problems (e.g. neural networks).
    - Proved the superlinear convergence rate and integrated the method into a PyTorch extension.
    - **Journal Submission (In Progress) :** *Journal of Optimization Theory and Applications*
    - **Collaborative Research :** Quasi-Newton Approximation for Bilevel Optimization.
  - **Almost Multisecant Quasi-Newton (QN) Method**
    - Solved convex optimization problems using **second-order quasi-Newton (QN)** methods, leveraging fast curvature approximation techniques and extending the BFGS algorithm.
    - Proposed a robust update scheme by interpolating past iterates to maintain the descent direction for minimizing machine learning problems.
    - **Conference Paper (Accepted, IEEE):** *2024 58th Asilomar Conference on Signals, Systems, and Computers* – "Almost Multisecant BFGS Quasi-Newton Method."
    - **Selected Conference Presentations:** NeurIPS OPT2023 (Workshop on Optimization for Machine Learning), CMS (Canadian Mathematical Society), and MOPTA (Modeling and Optimization Theory and Applications).
- **Kim's Numerical Analysis Research Lab** — Ewha W. University, South Korea
  Master's Thesis in Mathematics (Advisor: Prof. Sunyoung Kim) — *Jan. 2017 - Aug. 2019*
  - ***Solving Nonconvex Quadratic Constrained Quadratic Problems (QCQP) with Hollow Matrices***
    - Developed a computational method to solve QCQP efficiently by leveraging matrix sparsity.
    - Evaluated performance on nonconvex quadratic optimization using relaxation techniques, including Linear Programming (LP), Semidefinite Programming (SDP), and Second-Order Cone Programming (SOCP) with the SeDuMi package in MATLAB.
    - Proved mathematically that the optimal value of the SDP relaxation of the original QCQP is equivalent to that of the new LP, SDP, and SOCP relaxations.

Work Experience

- **Utopia Compression Corporation** — Los Angeles, California
  Research and Development(R&D) Engineer Intern — *Jan. 2023 - Aug. 2023, June. 2024 - Aug. 2024*
  - **Mathematical Modeling and Software Engineering**
    - Enhanced an existing e-commerce marketplace matching algorithm using constrained optimization techniques.
    - Solved Mixed Integer Programming (MIP) problems using Python and optimization software MOSEK to obtain optimal integer solutions for cost minimization.
    - Delivered end-to-end solutions by integrating the optimizer into the platform interface using BigCommerce API and GitHub, ensuring applicability for both frontend and backend operations.
- **AlphaCrest Capital Management LLC** — New York, Manhattan
  Research Intern in Quantitative Finance — *Aug. 2020 - June. 2021*
  - **Convex Optimization in Portfolio and Risk Management**
    - Implement the Relaxed Lasso method to solve the non-convex feature selection problem in both low and high signal-to-noise ratio (SNR) scenarios using Python and R (glmnet package).
    - Tuned parameters and preprocessed data to minimize prediction error on the validation set.
    - Analyze consecutive time periods in a time series dataset to identify and select relevant features.
    - Implement a Polyphase Filter Bank on alpha data to extract the meaningful feature trend beta.

Other Projects

- **Time series modeling for the stock market** — Stony Brook University, NY
  Research Assistant in Zhenhua's Lab — *Aug. 2021 - Dec. 2021*
  - Analyzed 2018 and 2019 time series training data to build the portfolio by setting different parameters such as volatility, transaction fee and rolling mean to achieve the maximum profit for the test data.
- **Statistics with Generalized Linear Model** — Ewha Womans University, South Korea
  Data Analysis — *Sept. 2017 - Dec. 2017*
  - Used big data, bird strikes and airplane damage, from Kaggle to derive the interrelationships and statistical information using R. Interpreted data and distinguished the model by setting a statistical threshold.

Scholarship and Fellowship

- **IACS Junior Researcher Award** — Stony Brook University, NY
  Institute for Advanced Computational Science (IACS) — *Aug. 2023 - Aug. 2025*
- **New Coming Graduate Student Fellowship** — Stony Brook University, NY
  Applied Mathematics and Statistics Department — *Aug. 2019*

Teaching Experience

- **Teaching Instructor** — Stony Brook University, NY
  Graph Theory : Managed 22 students including exams, projects, and office hours. — *July. 2020 - Aug. 2020*
- **Teaching Assistant** — Stony Brook University, NY
  Operations Research (Deterministic Models), Graph Theory — *Aug. 2019 - June. 2020*
- **Teaching Assistant** — Ewha Womans University, South Korea
  Calculus 1, Calculus 2, Mathematical Science and Information — *Mar. 2017 - June 2018*

Course Work

- Machine Learning, Artificial Intelligence, Linear Programming, Operations Research : Stochastic Models, Network flows, Probability, Numerical Analysis, Linear Regression, Numerical Differential Equations (Finite Difference, Finite Element method), and many more Applied Math and Statistics & Computer Science courses.