Moka (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

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**
    - Utilized Mixed Integer Programming (MIP) and the branch-and-bound algorithm to solve a constrained minimization problem, using Python Ortool package and the MOSEK optimization solver.
    - Enhanced an e-commerce marketplace bid matching algorithm/model and provided end-to-end solutions.
    - Based on buyers' demand from frontend order and sellers' supplies backend information, the algorithm allocates the feasible and optimal solution while minimizing the total order cost.
    - Integrated the optimizer into the BigCommerce API, automating real-time bid solution adjustments while maintaining frontend and backend via GitHub version control.
- **AlphaCrest Capital Management LLC** — New York, Manhattan
  Quant Research Intern in Finance — *Aug. 2020 - June. 2021*
  - **Convex Optimization in Portfolio and Risk Management**
    - Implemented the (simplified) Relaxed Lasso method to address 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.
    - Trained time series data from 2012 to 2020 for mid-frequency trading, aiming to identify a sparse coefficient solution that selects relevant columns in the predictor matrix X to minimize error.
    - Applied a Polyphase Filter Bank technique on alpha data to calculate a signal's frequency spectrum.

Research

- **PhD in the OptiML (Optimization and Machine Learning) Lab** — Stony Brook University, NY
  Advisor : Yifan Sun (CS) and Joseph Mitchell (AMS) — *Oct. 2020 - Present*
  - **Advancing Multi-Secant Quasi-Newton Methods for 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*
    - **Conference Paper (in progress)** : Quasi-Newton method 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, using supervised learning methods such as logistic regression.
  - **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.

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.