Moka (Mokhwa) Lee

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Education

- **Stony Brook University** — Stony Brook, NY
  PhD candidate in Applied Mathematics and Statistics (Operations Research Track) — *Aug. 2019 – Aug. 2025*
  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++
  Optimization Solvers: MOSEK, OR-Tools, SeDuMi, (familiar with Gurobi, CPLEX), etc
  Libraries & Frameworks: PyTorch, NumPy, SciPy, Scikit-learn, Pandas, glmnet, etc
  Technologies & Tools: GitHub, Postman, API integration (BigCommerce), Git, etc

Work Experience

- **Utopia Compression Corporation** — Los Angeles, California
  Research and Development (R&D) Engineer — *Jan. 2023 - Aug. 2023, June. 2024 - Aug. 2024*
  - **Mathematical Modeling and Software Engineering (full-stack development)**
    - Improved and extended a bid matching model to minimize total order cost using supply and demand data.
    - Solved a constrained combinatorial optimization problem using Mixed Integer Programming (MIP).
    - Used branch-and-bound algorithm implemented in Python (Ortools package) and the MOSEK solver.
    - Integrated the optimizer with the BigCommerce API, automating end-to-end communication through GitHub.
    - Deployed the solution from a development/testing environment to a live production system supporting real-time bid matching in an active online marketplace.
- **AlphaCrest Capital Management LLC** — New York, Manhattan
  Quantitative Researcher — *Aug. 2020 - June. 2021*
  - **Convex Optimization in Portfolio and Risk Management**
    - Implemented the Relaxed Lasso to address non-convex feature selection on mid-frequency time series data.
    - Applied regression analysis, L1 regularization (linear regression), by varying signal-to-noise ratios.
    - Used Python and R glmnet package (Lasso and Elastic-Net Regularized Generalized Linear Models).
    - Tuned hyperparameters and preprocessed data to minimize prediction error on the validation set.
    - Used Polyphase Filter Bank signal processing to extract robust trends via frequency spectrum analysis.

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*
  - **Publications**
    - Journal of Optimization Theory and Applications (JOTA)
      - "Advancing Multi-Secant Quasi-Newton Methods for General Convex Functions."
    - IEEE 2024 58th Asilomar Conference on Signals, Systems, and Computers
      – "Almost Multisecant BFGS Quasi-Newton Method."

* NeurIPS OPT2023 (Workshop on Optimization for Machine Learning)
  - "Almost Multisecant Quasi-Newton Method."
* Selected Conference Presentations
  - CMS (Canadian Mathematical Society) and MOPTA (Modeling and Optimization Theory and Applications)

- **Second order approximation for machine learning problems**
  * Solved convex problems using Quasi-Newton methods with efficient curvature approximations.
  * Developed a robust update scheme using past iterates to ensure descent direction in supervised learning tasks.
  * Extended multisecant BFGS to a limited memory version for scalable machine learning applications like logistic regression and neural networks.
  * Proved the superlinear convergence rate and integrated the method into a PyTorch extension.

Other Projects

- **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)
    * Used SeDuMi (Self-Dual-Minimization) software 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.

- **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

- **Young Writer's Award** — Stony Brook University, NY
  Institute for Advanced Computational Science (IACS) — *May 27, 2025*
- **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 (ML), Artificial Intelligence (AI), 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.