Hardik Tankaria, PhD

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Summary

PhD graduate in Machine Learning and Optimization with 6+ years of research experience at Kyoto University. Specialized in scalable optimization algorithms, predictive analytics, and large-scale, high-dimensional data. Strong record of publications and hands-on expertise in improving computational efficiency. Proven leadership through international presentations and cross-cultural team management. Looking for data scientist or ML engineer position with a focus on credit scoring, and consumer risk assessment to apply advanced data science and ML techniques to solve real-world problems.

Skills

Programming & Tools: Python, MATLAB, Git, GitHub, LaTeX, MySQL, Power BI(Beginner), SAS(Beginner)
Machine Learning & Data Science: Supervised & Unsupervised Learning, Classification, Regression, Neural Networks, Clustering, Gradient Boosting, Random Forest, Decision Trees
Optimization Techniques: Convex & Non-convex Optimization, Gradient Descent, Hyperparameter Optimization, Large-scale Optimization, Stochastic Optimization: (SGD, Adam, L-BFGS, Newton's method)
Model Evaluation: Cross-Validation, ROC-AUC, Precision/Recall, F1-Score, Confusion Matrix
Libraries, Frameworks & tools: scikit-learn, PyTorch, NumPy, Pandas, SciPy, CUTEst, Gurobi
Domain Knowledge: Credit risk modeling, loan default prediction, financial data analysis

Education

Kyoto University, Grad. School of Informatics **Apr 2018 – Mar 2024**
PhD in Mathematical Optimization - GPA: 3.7/4.0
Sponsored by Japan International Cooperation Agency (JICA)

Kyoto University, Grad. School of Informatics **Oct 2017 – Mar 2018**
Research Student in Mathematical Optimization

Indian Institute of Technology Hyderabad (IIT-H) **Aug 2014 – May 2016**
Master of Science in Mathematics
Hasse-Minkowski's Principle for Quadratic forms over Q, Arithmetic, Number theory

Saurashtra University, D.K.V. Arts & Science College **Jul 2011 – May 2014**
Bachelor of Science in Mathematics

Projects

Credit Card Default Prediction Model

- Developed a machine learning model using logistic regression and XGBoost to predict credit card defaults for the upcoming month. Cleaned data and engineered features from transactional data, improving prediction accuracy.
- Applied regularization to manage high-dimensional financial datasets with 30,000 samples and achieved an accuracy of prediction 81%.

Credit Score Prediction for Loans

- Cleaned and processed a dataset of 1,000 samples and 20 features to predict credit scores for loan applications.
- Applied logistic regression and XGBoost, obtained multi-section credit score classification based on client scores.
- Preprocessed data for model training, including handling missing values and feature scaling, improving model interpretability and performance.
- Provided insights for automated loan approval systems using score segmentation aligned with industry-grade thresholds.

Stochastic Variance Reduced Gradient with Barzilai-Borwein Method

- Developed a new SVRG2BB algorithm that incorporated Barzilai-Borwein step-size as second-order information to improve convergence in stochastic optimization.
- Developed and proposed a novel BB-step size variant for variance-reduced gradient methods, significantly improving computational efficiency and reducing training time on large-scale datasets.

- Demonstrated the effectiveness of the algorithm on benchmark datasets (Gisette, Covtype, IJCNN, MNIST) using classification tasks (logistic regression, SVM), outperforming baseline methods and reduced complexity from O(nd^2) to O(ndm).

Scalable Optimizer for Empirical Risk Minimization

- Developed NysReg-Gradient, a 1.5th-order optimization method using regularized Nyström approximation to efficiently integrate Hessian information into gradient-based learning for high-dimensional datasets.
- Reduced complexity from O($nd^2 + d^3$) to O($dm^2 + m^3 + ndm$) where m is 5-20% of features d, optimizing training reducing computational CPU time by 50-70%, improving convergence speed and classification accuracy for large-scale optimization problem and high-dimensional benchmark datasets.
- Applied the method to deep learning and medical imaging tasks, demonstrating superior performance on MRI brain tumor classification and ImageNet training compared to SGD, L-BFGS, and KFAC.
- Developed a regularized Nyström optimizer for brain tumor detection from MRI images using transfer learning, achieving an 88% classification accuracy.
- Presented research findings at esteemed international conferences, showcasing innovation in scalable matrix approximations

Work Experience

Research Associate **Dec 2024 – Feb 2025**

Indian Institute of Technology, Mandi, India

- Developing Nyström-based ADMM Optimization algorithm for Federated Learning to improve computational efficiency
- Investigating distributed convex and non-convex optimization techniques for large scale decentralized training
- Analyzing convergence and reducing communication overhead using quantization using Python
- Preparing research paper for submission to top-tier ML/Optimization Journal/conference

E-Commerce & Back Office (Part time) **May 2021 – Oct 2024**

Hayakawa Co. LTD., Kyoto, Japan

- Conducted in-depth market research and trend analysis for e-commerce platforms, optimizing auto parts listings to boost global sales on eBay and Amazon
- Managed client relations while facilitating negotiations, and ensuring customer satisfaction, contributing to securing major orders and achieving consistent sales growth
- Streamlined online sales operations, processes and enhanced productivity through process optimization using Excel and MS Office Suite
- Identified key sales trends and provided actionable insights, enhancing strategic decision-making and improving sales targets
- Experience in financial transactions and consumer data during client negotiations and sales cycle

Research Assistant **Dec 2021 – Mar 2023**

Dept. of Intelligence Science & Technology, Kyoto University

- Assisted in the development and evaluation of scalable optimization algorithms for high-dimensional machine learning applications.
- Focused on second-order and quasi-second-order methods, contributing to academic publications and experimental validation.

Online Expert of Mathematics **Nov 2016 – Jun 2017**

Chegg India Pvt. Ltd

- Created a series of in-depth tutorials covering complex mathematical concepts
- Provided accurate, expert-level solutions to complex graduate-level mathematics problems, demonstrating strong analytical, problem-solving skills

Publications

A Regularized Limited Memory BFGS Method for Large-Scale Unconstrained Optimization, Computational Optimization Applications 82, 61–88 (2022). DOI: 10.1007/s10589-022-00351-5
Hardik Tankaria, Shinji Sugimoto and Nobuo Yamashita

A Stochastic Variance Reduced Gradient using Barzilai-Borwein Techniques, Journal of Industrial and Management Optimization, 2024, 20(2): 525-547. DOI: 10.3934/jimo.2023089
Hardik Tankaria and Nobuo Yamashita

Industrial Project- Kioxia

- Developed scalable stochastic optimization algorithms, including SVRG-RL-BFGS, by integrating quasi-Newton and variance reduction techniques, significantly reducing computational cost for large-scale ML problems.
- Improved optimization efficiency and accuracy on high-dimensional datasets using random projection and enhanced regularization methods, validated through benchmark experiments.
- Reduced complexity by a factor of d (number of parameters) while maintaining model performance.

Conferences and Talks

- Reducing Variance of Stochastic Gradient using Barzilai-Borwein method as second-order information, 20th Joint research meeting of the Japan Society for Industrial and Applied Mathematics (JSIAM), Nagaoka Institute of Technology, Niigata, Japan - February 2024
- A Stochastic variance reduced gradient using second order information, 10th International Congress on Industrial and Applied Mathematics (ICIAM), Waseda University, Tokyo, Japan - August 2023.
- Nys-Newton: Nyström approximated curvature information for convex optimization at (IBISML) Information based Induction Sciences and Machine Learning (online), December 2022
- Nys-Transfer: Nyström approximated Newton-sketch for Fine-tuning the Deep Nets for Brain MRI, International Symposium on Artificial Intelligence & Brain Science, Okinawa Institute of Science & Technology (OIST), Okinawa, Japan – July 2022
- Regularized L-BFGS method for Large Scale Unconstrained Optimization at 6th International Conference on Continuous Optimization (ICOPT), Berlin- Germany - August 2019.
- Technical Review of Scientific Articles: International Conference of Machine Learning, 2022(ICML)

Preprints

NysReg-Gradient: Regularized Nyström-Gradient for Large-Scale Unconstrained Optimization and its Application, 2023
Hardik Tankaria, Dinesh Singh, and Makoto Yamada.

Regularized Nyström method for Large-Scale Unconstrained Non-Convex Optimization, 2024
Hardik Tankaria

Awards & Scholarships

- **KIOXIA Industrial Project Funding**- Secured ¥1 million funding to develop scalable stochastic optimization algorithms (Apr 2019 – Mar 2020)
- **JICA Scholarship for PhD**- Awarded Japan International Cooperation Agency (JICA) Scholarship for PhD at Kyoto University (Oct 2017 – Mar 2021)
- **GSET Qualification** - Cleared GSET for Assistant Professor in Govt. Univ., Gujarat, India (Nov 2017)
- Awarded MCM Scholarship during master's program (2015)

Leadership & Extracurriculars

President - Indian Association of Kyoto **2022 – 2024**

- Led cultural organization to celebrate Indian festivals and connect Indian community in Kyoto
- Managed team and coordinated multiple cultural events

Languages

Japanese (Beginner) • English (Business) • Gujarati (Native) • Hindi (Native)