He (Evelyn) Lyu

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Education

Michigan State University	**Sep 2018 – May 2023**
Ph.D. in Computational Mathematics, Science and Engineering. GPA: 4.00/4.00	*East Lansing, MI*

Award: CMSE Outstanding Early Student Award, 2019

Fudan University	**Sep. 2012 – June 2016**
B.S. in Mathematics and Applied Mathematics, Minor in Economics. GPA: 3.58/4.00	*Shanghai, China*

Award: First Prize Scholarship, 2015

Relevant Coursework

- Math Foundations of Data Science
- Optimization
- Parallel Computing
- Mathematics of Deep Learning
- Algorithmic Graph Theory
- Probability Theory

Technical Skills

Languages: Python, MATLAB, C++, SQL
Frameworks & Tools: PyTorch, TensorFlow, Sklearn, MPI, Linux, Git, GitHub

Industrial Experience

Meta Platforms, Inc. (Facebook)	**May 2022 – Aug. 2022**
Machine Learning Software Engineer Intern	*Ads Core ML - ML Automation & Productionisatioin*

- Optimizing model architecture: designed a **statistical** method to quantify the effectiveness of each Neural Network modeling technique, optimized **Ads Ranking** models by incorporating the techniques identified to be effective.
- Optimizing model hyperparameters: trained **predictive models** and applied Monte Carlo simulation to find the model hyperparameters with best **QPS-Accuracy tradeoff**.
- Optimized 7 Ads Ranking models (Instagram, Facebook story, etc.,) with total revenue share **4.12%**, offline classification performance improved over **0.5%** on 4 models, prepared for the online **A/B testing**.

Selected Research Projects

Implicit Regularization in Heavy-ball Momentum SGD | *Optimization, Deep Learning*   **May 2022 - Sep. 2022**
- Derived an implicit regularization analysis for Stochastic Gradient Descent with Heavy-ball momentum, which provides theoretical insights on how **momentum** affects the generalization performance of **SGD**.
- Validated the theoretical analysis by numerical experiments on image classification tasks using large **Convolutional Neural Networks** and real-world datasets including **Computer Vision** datasets CIFAR10 and CIFAR100.

Sigma Delta Quantization for Images | *Image Quantization, Optimization, Super-resolution*   **Sep. 2018 - May 2020**
- Proposed and analyzed an adaptive **quantization** method for direct digital image acquisition that obtains a better information conversion rate than the state-of-the-art method in cameras.
- Designed and implemented a scalable algorithm for solving the **optimization** problem involved.
- **Patent pending**.

Matrix Perturbation Analysis and Its Statistical Applications | *Statistical theory*   **June 2020 - Dec. 2020**
- Established a set of a collection of improved error bounds on SVD perturbation related problems.
- The improved error bounds can be applied to **clustering, classification**, and **dimension reduction** methods.

Manifold Denoising by Nonlinear Robust PCA | *Machine learning, Manifold learning*   **Mar. 2019 - May 2019**
- Proposed and analyzed an algorithm that extends robust principal component analysis (RPCA) to nonlinear manifolds, which can be applied to manifold denoising tasks.
- Applied **FISTA** algorithm to solve the **optimization** problem involved.

Selected Publications

* denotes equal contribution

[1] **Lyu, H.**, Sha, N., Qin, S., Yan, M., Xie, Y. and Wang, R., "Manifold Denoising by Nonlinear Robust Principal Component Analysis". **Advances in Neural Information Processing Systems 32 (NeurIPS 2019)**. [Paper]

[2] **Lyu, H.** and Wang, R., "Sigma Delta quantization for images". To appear at **Communications on Pure and Applied Mathematics**, 2023. [Paper]

[3] Ghosh, A.* **Lyu, H.***, Zhang, X. and Wang, R., "Implicit regularization in Heavy-ball momentum accelerated stochastic gradient descent". To appear at **International Conference on Learning Representations (ICLR 2023)**. [Paper]

[3] **Lyu, H.** and Wang, R., "An exact sinΘ formula for matrix perturbation analysis and its applications". Under Review at *Annals of Statistics*, 2020. [Paper]

[4] **Lyu, H.** and Wang, R., "Perturbation of invariant subspaces for ill-conditioned eigensystem", 2022. [Paper]