YUCONG LIU

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EDUCATION

Georgia Institute of Technology
Ph.D. in Machine Learning, School of Mathematics *2023/8 - Present*

University of Chicago
MS in Statistics (Ph.D. level theoretical statistics sequence), Department of Statistics *2021/9 - 2023/6*
GPA: 3.96/4.0

Peking University
BS in Data Science and Big Data Technology, School of EECS *2017/9 - 2021/7*
Major GPA: 3.58/4.0
BS in Mathematics and Applied Mathematics, School of Mathematics Science *2018/9 - 2021/7*

PUBLISHED ARTICLES

Hessian regularization of deep neural networks: A novel approach based on stochastic estimators of Hessian trace (Neurocomputing)
Yucong Liu, Shixing Yu, Tong Lin
GraphPrompt: Graph-Based Prompt Templates for Biomedical Synonym Prediction (AAAI 2023)
Jiayou Zhang, Zhirui Wang, Shizhuo Zhang, Megh Manoj Bhalerao, **Yucong Liu**, Dawei Zhu, Sheng Wang

ARTICLES UNDER REVIEW

LU decomposition and Toeplitz decomposition of a neural network (arXiv)
Yucong Liu, Simiao Jiao, Lek-Heng Lim Submitted to Applied and Computational Harmonic Analysis
Path-following methods for Maximum a Posteriori estimators in Bayesian hierarchical models (arXiv)
Zilai Si*, **Yucong Liu***, Alexander Strang Submitted to SIAM Journal on Optimization
Functional Principal Trade-off Analysis: Universal Approximation via Disc Game Embedding
Ruizheng Bai, **Yucong Liu**, Qingyao Sun, David SeWell, Alexander Strang Submitted to SIAM Journal on Mathematics of Data Science
Neural Networks are Integrable
Yucong Liu Submitted to Neural Networks

ARTICLES IN PREPARATION

On the Utility Recovery Incapability of Neural Net-based Differential Private Tabular Training Data Synthesizer under Privacy Deregulation (arXiv)
Yucong Liu, Chi-Hua Wang, Guang Cheng

RESEARCH EXPERIENCE

Algebraic Structure of High-Order Neural Networks *2023/8 - Present*
Ongoing Work, Independent Research, Advised by Prof. Lek-Heng Lim *University of Chicago*

· Study the connection between Tropical geometry, piece-wise linear functions and ReLU neural networks
· Define algebra for piece-wise polynomials and neural networks.

Privacy under Federated Learning and Split Learning *2023/6 - Present*
Ongoing Work, Collaborated Research *Valmech*

· Design algorithms under the framework of federated learning and split learning but protect data privacy and agent privacy.

· Make theoretical analysis on the algorithms.

Statistical Analysis on Stochastic Gradient Descent *2023/6 - Present*
Ongoing Work, advised by Prof.Florian Schäfer *Georgia Institute of Technology*

· Define SGD by the idea of Bootstrap.
· Design experiments to test bootstrap variance of SGD.

Sample Fluid in Bayesian Hierarchical Models *2023/4 - Present*
Ongoing Work, advised by Prof. Alexander Strang *University of Chicago*

· Design algorithms and experiments to track samples amidst changes in distribution.

Data Separation under GNN *2023/2 - Present*
Ongoing Work, advised by Prof. Weijie Su *University of Pennsylvania*

· Test the trend of Data Separation beyond general neural network, especially on GCN.

Functional Principal Trade-off Analysis *2022/8 - Present*
Independent Research, advised by William H. Kruskal Instructor Alexander Strang *University of Chicago*

· Analyze the problem in Hilbert Space and prove the eigen-expansion of desired form.
· Work on the convergence rate of the orthogonal expansion.

LU decomposition and Toeplitz decomposition of a neural network *2022/6 - 2022/11*
Independent Research, advised by Prof. Lek-Heng Lim *University of Chicago*

· Prove the existing Universal Approximation Theorem holds for LU Neural Networks and Toeplitz Neural Networks under both arbitrary depth case and arbitrary width case.
· Design experiments on three different models and three datasets to show that there is no obvious performance loss on LU networks and Toeplitz networks, compared with general Neural Networks.

Differential Privacy *2022/6 - Present*
Independent Research, advised by Prof. Cheng Guang *UCLA*

· Implement existing algorithms for differential privacy, including Bayesian network methods and Generative Adversarial Networks-based algorithms.
· Discover and analyze the shortcomings of existing methods, which can be summarized as the phenomenon of failing on utility recovery.

Path-following method on Inverse Problem *2022/2 - 2022/11*
Independent Research, advised by William H. Kruskal Instructor Alexander Strang *University of Chicago*

· Prove the Hessian matrix is almost surely invertible.
· Show the first-order optimality and the invertibility of Hessian imply an ODE and the ODE admits a unique solution.

Hessian Regularization on Deep Learning *2020/10 - 2021/11*
Independent Research, advised by Prof. Tong Lin *Peking University*

· Propose a novel Hessian Regularization by penalizing the Hessian trace.
· Implement Hutchinson Estimator in deep Neural Networks.
· Design a new estimator for the partial sum of diagonal entries.
· Design experiments on four models, three datasets and two machine learning tasks to show the performance of our method.

MENTEE

Leah Injaty, Georgia Tech (2023 - present)

ACTIVITIES

Reviewer at SyntheticData4ML Workshop *NeurIPS 2022*
Organizer of Machine Learning Theory Student Seminar
Student Seminar Talk on Universal Approximation Theorem of Deep Learning at the Student Seminar
Grader of STAT 24410, 24500, 24510 at *University of Chicago*

UNDERGRADUATE RESEARCH EXPERIENCE

Event Study and Factors Testing in Financial Market *2020/2 - 2020/12*
Research Assistant, advised by Prof. Yingguang Zhang, Guanghua School of Management *Peking University*

- Write Python program and use financial report as event to build company financial database, including basic company information, daily trading data, analysts' information and forecast data
- Verify the accuracy of analysts' forecasts and the relationship of analysts' forecasts and real returns by regression
- Replicate Fama-French factors based on papers about factors and anomalies and test size and value in China

Cluster Control and Collaboration of Driverless Car *2019/6 - 2020/10*
Undergraduate Research Project, advised by Prof. Lingyang Song, School of EECS *Peking University*

- Build system of Raspberry Pi, radar and car to be able to explore environment and move accurately
- Finish A star algorithm and SLAM for the car to build the map and localize automatically
- Build socket connection and design a cluster control algorithm based on Leader-Follower model

PROFESSIONAL EXPERIENCE

Valmech Shanghai(remote), China
Researcher *2023/6 - Present*
Techfin.ai Shenzhen(remote), China
Deep Learning Intern *2020/6 - 2020/10*
Bgain Digital Beijing, China
Quantitative Research Intern *2020/6 - 2020/9*
Turing Ideas Shanghai(remote), China
Quantitative Analyst Intern *2020/5 - 2020/6*
Changjiang Securities Beijing, China
Quantitative Research Intern *2020/1 - 2020/4*
Byte Dance Beijing, China
Back End Developer Intern *2019/6 - 2019/9*