Xuran Meng

E-mail: xuranmeng@connect.hku.hk Personal Website: https://xuranmeng.github.io

EDUCATION BACKGROUND

The University of Hong Kong (HKU) 09/2020-now
Major: Statistics GPA: - Degree: Doctor

University of Science and Technology of China (USTC) 09/2018-07/2020
Major: Statistics GPA: 3.51/4.3 Degree: Master

School of the Gifted Youth, University of Science and Technology of China (USTC) 09/2014-06/2018
Major: Statistics GPA: 3.63/4.3 Degree: Bachelor

PUBLICATIONS

[1] Meng X, Yao J. Impact of classification difficulty on the weight matrices spectra in deep learning and application to early-stopping[J]. ***Journal of Machine Learning Research*****,** 2023, 24: 1-40.
[2] Zhang J, Zhang S, Meng X. l_{1-2} minimisation for compressed sensing with partially known signal support[J]. ***Electronics Letters*****,** 2020, 56(8): 405-408.

PREPRINTS

[1] Meng X, Yao J, Cao Y. Multiple descent in the multiple random feature model[J]. Preprint arXiv:2208.09897, 2022. *(Revision under review of **JMLR**)*
[2] Meng X, Cao Y, Zou D. Per-example gradient regularization improves learning signals from noisy data[J]. Preprint arXiv:2303.17940, 2023.
[3] Meng X, Zou D, Cao Y. Benign overfitting in two-layer ReLU convolutional neural networks for XOR data[J]. Preprint arXiv: 2310.01975, 2023.

RESEARCH EXPERIENCE

Benign overfitting in two-layer ReLU convolutional neural networks for XOR data
06/2023-09/2023

- proved that convolutional neural networks have a remarkable capacity to efficiently learn XOR problems, even in the presence of highly correlated features;
- established matching upper/lower bounds on the test error of two-layer CNNs in learning XOR-type data under gradient descent; introduced "virtual sequence comparison" technique to analyze the learning of highly correlated XOR-type data; conducted experiments to back up the theory;
- preprinted the paper on *arXiv 2310.01975*.

Per-example gradient regularization improves learning signals from noisy data
12/2022-03/2023

- found gradient regularization mitigates the negative impact of noise memorization, while having a relatively minor impact on signal learning;
- considered a two-layer convolutional neural network with gradient regularization; analyzed the dynamics under gradient descent and found that gradient regularization prioritizes learning the

signal over memorizing the noise, leading to a high test accuracy; conducted synthetic and real data experiments to back up our theory;
- preprinted the paper on *arXiv 2303.17940*.

Multiple descent in the multiple random feature model 12/2021-08/2022
- established a precise analysis of multiple descent curve in double/multiple random feature models;
- extended the previous work which showed double descent curve in random feature models, theoretically showed the triple descent and multiple descent curves, and conducted simulations to verify the theory;
- preprinted the paper on *arXiv 2208.09897*.

Impact of classification difficulty on the weight matrices spectra in deep learning and application to early-stopping 03/2021-11/2021
- proposed spectral criterion to guide early stopping based on the discovery that the more classification difficulty, the more probability "Heavy Tail" phenomenon emerges;
- conducted extensive experiments and simulations to investigate "Heavy Tail" phenomenon in weight matrices spectra in deep learning; proposed spectral criterion based on "Heavy Tail" phenomenon to guide the early stopping in deep learning; conducted synthetic and real data experiments to verify the criterion;
- published a paper on *Journal of Machine Learning Research,* 2023.

INTERNSHIP

Application for the grant. 09/2023
- established a research proposal with Prof. Johannes Heiny.

Conference of Random Matrix Theory and Applications. 06/2023
- the local committee in RMTA2023;
- had a poster in RMTA2023.

Shanghai Mengxi Investment Management Co., Ltd. 06/2018-08/2018
- established a strategy system based on Python language that covered class function, library function calls, text recognition and statistic methods, achieved one-key factor like Worldquant;
- introduced the training model of machine learning to improve goodness-of-fit, including the variable screening in data dimensionality reduction, and the lasso and ridge regression.

HONORS & AWARDS

Postgraduate Scholarships, Department of Statistics and Actuarial Science, HKU	09/2020
First Class Student Scholarship, School of Management, USTC	09/2018
Financial Risk Manager, Level 1, Garp Association	05/2017
Third Prize of Excellent Student Scholarship, School of the Gifted Youth, USTC	12/2017
Third Prize of Excellent Student Scholarship, School of the Gifted Youth, USTC	12/2014

OTHER SKILLS

Computer Skills: be proficient in R, Python and C++