



THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

**SEMINAR ON DATA SCIENCE
AND APPLIED MATHEMATICS**

**Be aware of model capacity when talking
about generalization in machine learning**

By

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Abstract

Machine learning (ML) generally operates in high-dimensions, of which the performance is characterized by learning efficiency—both theoretically (statistical and computational efficiency) and empirically (practical efficient ML). A fundamental question in ML theory and practice is how the test error (generalization) evolves with sample size and model capacity (e.g., model size), shaping key concepts such as the bias-variance trade-offs, double descent, and scaling laws.

In this talk, I will discuss how the test error will behave if a more suitable metric than model size for model capacity is used. To be specific, I will present a unified perspective on generalization by analyzing how norm-based model capacity control reshapes our understanding of these foundational concepts: there is no bias-variance trade-offs; phase transition exists from under-parameterized regimes to over-parameterized regimes while double descent doesn't exist; scaling law is formulated as a multiplication style under norm-based capacity. Additionally, I will briefly discuss which norm is suitable for neural networks and what are the fundamental limits of learning efficiency imposed by such norm-based capacity from the perspective of function space.

Talk is based on <https://arxiv.org/abs/2502.01585>, <https://arxiv.org/abs/2404.18769>

Bio: Dr. Fanghui Liu is currently an assistant professor at University of Warwick, UK, a member of Centre for Discrete Mathematics and its Applications (DIMAP). His research interests include foundations of machine learning as well as efficient machine learning algorithm design. He was a recipient of AAI'24 New Faculty Award, Rising Star in AI (KAUST 2023), co-founded the fine-tuning workshop at NeurIPS'24, and served as an area chair of ICLR and AISTATS. Besides, he has delivered three tutorials at ISIT'24, CVPR'23, and ICASSP'23, respectively. Prior to his current position, he worked as a postdoc researcher at EPFL (2021-2023) and KU Leuven (2019-2023), respectively. He received his PhD degree from Shanghai Jiao Tong University in 2019 with several Excellent Doctoral Dissertation Awards.

Date : 31 March 2025 (Monday)

Time : 6:30p.m.

Venue : G009A, CYT Bldg.

All are Welcome!