



THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON APPLIED MATHEMATICS

Regularized Learning in Reproducing Kernel Banach Spaces

By

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Abstract

Regularized learning is the contemporary framework for learning to generalize from finite samples (classification, regression, clustering, etc). Here the problem is to learn an input-output mapping $f: X \rightarrow Y$ given finite samples $\{(x_i, y_i), i=1, \dots, N\}$. The learning-from-data problem is then formulated as an optimization problem in a function space, with the objective function consisting of a loss term $L(f)$ capturing its goodness-of-fit (or the lack thereof) on given samples $\{(f(x_i), y_i), i=1, \dots, N\}$, and a penalty term $R(f)$ capturing its complexity based on prior knowledge about the solution (smoothness, sparsity, etc). This results in the celebrated Reproducing Kernel Hilbert Space methods in machine learning. Here, we will remove the Hilbert space restriction, i.e., the existence of an inner product, and show that the key ingredients of this framework (reproducing kernel, representer theorem, feature space) remain to hold for a Banach space that is uniformly convex and uniformly Frechet differentiable. Central to our development is the use of a semi-inner product operator and duality mapping for a uniform Banach space in place of an inner-product for a Hilbert space. This opens up the possibility of unifying kernel-based methods (regularizing L_2 -norm) and sparsity-based methods (regularizing l_1 -norm), which have so far been investigated under different theoretical foundations. (Joint work with Haizhang Zhang and Yuesheng Xu).

Biosketch

Jun Zhang is a Full Professor at the University of Michigan, Ann Arbor, where he has worked since 1992 as a tenure-track and then tenured faculty in the Department of Psychology, with adjunct appointments in the Department of Mathematics, Department of Statistics, and Michigan Institute of Data Sciences. He has held various visiting positions at the University of Melbourne (Australia), CNRS (France), University of Waterloo (Canada), RIKEN Brain Science Institute (Japan), CMSA at Harvard, and a number of positions in China including a recent appointment at the newly established Shanghai Institute of Mathematics and Interdisciplinary Sciences (SIMIS), China. Professor Jun Zhang works in the interdisciplinary field of mathematical psychology, computation neuroscience, computation cognitive science, machine learning, and geometric science of information (information geometry). He is an elected fellow of Association for Psychological Sciences (APS) and Psychonomic Society, and co-Editor of the Springer journal Information Geometry.

Date : 13 December 2024 (Friday)

Time : 2:00p.m. – 3:00p.m.

Venue : Room 4579 (near Lift 27/28)

All are Welcome!