Deep Learning, Prediction and Validation: Modelling and Analysis of Complex Data in Modern Science and Technology

Date: December 6, 2017 (Wednesday)
Time: 6:00 pm (tea reception from 5:15 pm)
Venue: Lecture Theatre P4, LG1/F, Chong Yuei Ming Physics Building, HKU

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ABSTRACT
Concerning "prediction" and "modelling" in the title, we begin with a review of (a) recent advances in computer vision and deep learning, (b) the underlying mathematical theory of convolutional neural networks, gradient descent, and hidden Markov random fields, and (c) AI applications to medical imaging and fast automated analysis of strong gravitational lenses in astrophysics. Whereas high-performance computing and advanced programming have overcome the computational hurdles in the analysis of "big data" in modern science and technology, we show how novel mathematical methods and statistical principles can provide major breakthroughs in the "validation" of scientific theories based on complex experimental data. Because big data typically require variable/hypothesis selection based on some sparsity assumption to make the inference problem feasible, there is contemporaneous awareness of how this complexity has led to irreproducible research in modern science. We describe statistical innovations in post-selection inference and hybrid resampling to address this "reproducible (replication) crisis", and illustrate our point with the care in collecting data and their analysis in the Higgs boson experiments.

ABOUT THE SPEAKER
Tze Leung Lai is Professor of Statistics in the School of Humanities and Sciences, and by courtesy, of Biomedical Data Science in the School of Medicine and of Computational and Mathematical Engineering in the School of Engineering at Stanford University. He is also Director of the Financial and Risk Modeling Institute at Stanford, and Co-director of the Mathematical and Computational Finance Program, of the Biostatistics Core at the Cancer Institute and of the Center for Innovative Study Design at Stanford. He received his B.A. (First Class Honours) in Mathematics from The University of Hong Kong in 1967 and his Ph.D. in Mathematical Statistics in 1971 from Columbia University, where he stayed on the faculty until he moved to Stanford University in 1987. He won the Committee of Presidents of Statistical Societies Award in 1983 and the Abraham Wald Prize in Sequential Analysis in 2005. He is an elected member of Academia Sinica, where he has been an Advisory Committee member of the Institute of Statistical Science since 1992. He is also an Advisory Committee member of the Department of Statistics and Actuarial Science and of the Institute of Mathematical Research at HKU, and of the Statistics Center at Peking University, the Mathematical Sciences Center at Tsinghua University, and the School of Economics at Fudan University. He has published 14 books, 300 papers, and has supervised 73 PhD students.

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