Mathematical Colloquium Series

Department of Mathematics

Faculty of Science and Technology

Learning Through Deterministic Assignment Of Hidden Parameters

Date: 21 April 2015 (Tuesday)

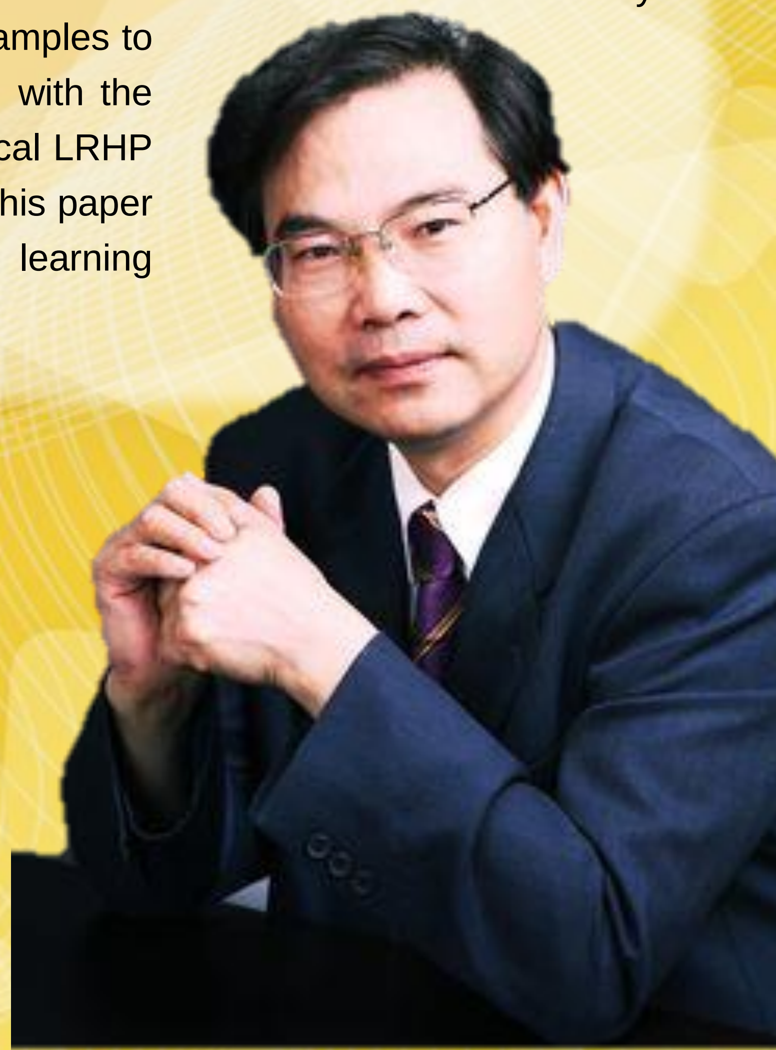
Time: 3:00p.m.

Venue: E12 – G003

Abstract

Supervised learning boils down to determining hidden and bright parameters in a parameterized hypothesis space based on a finite number of input-output pairs. The hidden parameters determine the hidden predictors or nonlinear mechanism of an estimator, while the bright parameters characterize how the hidden predictors are linearly combined or the linear mechanism. In traditional learning paradigm, the hidden and bright parameters are not distinguished and trained simultaneously in one learning process. Such an one-stage learning (OSL) brings a benefit of theoretical analysis but suffers severely from the very high computation burden. To overcome this difficulty, a two-stage learning scheme (TSL), featured by learning through random assignment for hidden parameters (LRHP), that assigns randomly the hidden parameters in the first stage and determines the bright parameters by solving a linear least squares problem in the second stage. LRHP works well in many applications but suffers from the uncertainty problem: its performance can be guaranteed only in a certain statistical expectation sense.

In this talk we propose a new TSL scheme: the learning through deterministic assignment of hidden parameters (LDHP). Borrowed from an approximate solution of the classical hard sphere problem and by applying the homeomorphism principle in mathematics, we suggest to deterministically take the hidden parameters as the tensor product of the minimal Riesz energy points on sphere and the best packing points in an interval. We theoretically show that with such deterministic assignment of hidden parameters, LDHP almost shares the same generalization performance with that of OSL, i.e., it does not degrade the generalization capability of OSL. Thus LDHP provides a very effective way of overcoming both the high computation burden of OSL and the uncertainty. difficulty in LRHP. We present a series of simulation and application examples to support such advantages and outperformance of LDHP, as compared with the typical OSL algorithm -- Support Vector Regression (SVR) and the typical LRHP algorithm -- Extreme Learning Machine (ELM). The study conducted in this paper paves a new road to simply and more efficiently solve supervised learning problems



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