

*Special one-week intensive course*

**“Nonlinear numerical optimization  
and  
multi-stage neural-network learning”**

at Tokyo Metropolitan University

for Aug. 29 – Sept. 2, 2011

*Instructor:*

國立台灣科技大學助教授 水谷英二 先生 (Prof. Eiji Mizutani)

*Course description:*

We begin with fundamentals of unconstrained nonlinear optimization; such as, classification of stationary points, descent direction conditions, evaluations of the gradient vector and Hessian matrix, line search, and trust region methods.

We then consider learning with a multilayer perceptron (MLP) and a CANFIS neuro-fuzzy modular network that consists of multiple local-expert MLPs. Since an MLP has a nice multi-stage structure, we discuss how to exploit it so as to design efficient optimization algorithms for learning.

On August 30, we use MATLAB for reviewing basic Numerical Linear Algebra, which plays a pivotal role in numerical optimization. Before the course begins, students, who are not familiar with MATLAB, are encouraged to leaf through a MATLAB primer available on the web; e.g., refer to the following chapter on linear-equation solving:

<http://www.mathworks.com/moler/exm/chapters/linear.pdf>  
(for individual use only)

at the homepage of Cleve Moler.

During the week, several in-class quizzes will be given as well as MATLAB exercises and homework.

If the time permits, we advance to a so-called variable projection algorithm for separable least squares problems; one may refer to

Section 5.8 in <http://www.mathworks.com/moler/leastquares.pdf>  
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and our recent investigation (EJ2011onVP.pdf, joint work with Jim Demmel).