

White-Box Deep (Convolution) Networks from First Principles

Date: 06 October 2021 (Wednesday)

Time: 10:00am - 11:00am

Seminar link: <https://cityu.zoom.us/j/98970191043>



ABSTRACT

In this talk, we offer an entirely “white box” interpretation of deep (convolution) networks from the perspective of data compression (and group invariance). In particular, we show how modern deep layered architectures, linear (convolution) operators and nonlinear activations, and even all parameters can be derived from the principle of maximizing rate reduction (with group invariance). All layers, operators, and parameters of the network are explicitly constructed via forward propagation, instead of learned via back propagation. All components of so-obtained network, called ReduNet, have precise optimization, geometric, and statistical interpretation. There are also several nice surprises from this principled approach: it reveals a fundamental tradeoff between invariance and sparsity for class separability; it reveals a fundamental connection between deep networks and Fourier transform for group invariance – the computational advantage in the spectral domain (why spiking neurons?); this approach also clarifies the mathematical role of forward propagation (optimization) and backward propagation (variation). In particular, the so-obtained ReduNet is amenable to fine-tuning via both forward and backward (stochastic) propagation, both for optimizing the same objective.

This is joint work with students Yaodong Yu, Ryan Chan, Haozhi Qi of Berkeley, Dr. Chong You now at Google Research, and Professor John Wright of Columbia University.

A related paper can be found at:
<https://arxiv.org/abs/2105.10446>



Prof Yi MA GUEST SPEAKER'S PROFILE

Prof Yi Ma is a Professor at the Department of Electrical Engineering and Computer Sciences at the University of California, Berkeley. His research interests include computer vision, high-dimensional data analysis, and intelligent systems. Prof Ma received his Bachelor's degrees in Automation and Applied Mathematics from Tsinghua University in 1995, two Masters degrees in EECS and Mathematics in 1997, and a PhD degree in EECS from UC Berkeley in 2000. He has been on the faculty of UIUC ECE from 2000 to 2011, the principal researcher and manager of the Visual Computing group of Microsoft Research Asia from 2009 to 2014, and the Executive Dean of the School of Information Science and Technology of ShanghaiTech University from 2014 to 2017. He then joined the faculty of UC Berkeley EECS in 2018.

Prof Ma has published about 60 journal papers, 120 conference papers, and three textbooks in computer vision, generalized principal component analysis, and high-dimensional data analysis. He received the NSF Career award in 2004 and the ONR Young Investigator award in 2005. He also received the David Marr prize in computer vision from ICCV 1999 and best paper awards from ECCV 2004 and ACCV 2009. He has served as the Program Chair for ICCV 2013 and the General Chair for ICCV 2015. He is a Fellow of IEEE, ACM, and SIAM.

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All are welcome