Can Deep Learning Learn to Count? on cognitive deficit of the current state of deep learning

SPEAKER **Xiaolin WU**

NSERC Senior Industrial Research Chair, McMaster Distinguished Engineering Professor
Department of Electrical & Computer Engineering McMaster University Canada

DATE 8 May, 2023 (Mon)
TIME 10:00 AM - 11:00 AM
VENUE Y6405, CS Seminar Room, 6/F., Yellow Zone, Yeung King Man Academic Building, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon Tong, Hong Kong

ABSTRACT

Subitizing, or the raw number sense, is an innate cognitive function of humans and primates; it responds to visual stimuli prior to the development of any symbolic skills, language or arithmetic. Given successes of deep learning (DL) in tasks of visual intelligence and given the primitivity of number sense, a tantalizing question is whether DL can comprehend numbers and acquire the ability of subitizing. But somewhat disappointingly, extensive experiments of the type of cognitive psychology demonstrate that the examples-driven DL cannot see through superficial variations in visual representations and distill the abstract notion of natural number, a task that children perform with high accuracy and confidence. The failure is apparently due to the learning method not the connectionist CNN machinery itself. A recurrent neural network capable of subitizing does exist, which we construct by encoding a mechanism of mathematical morpholsogy into the CNN convolutional kernels. Also, we investigate, using subitizing as a test bed, the ways to aid the black box DL by cognitive priors derived from human insight. Our findings are mixed and interesting, pointing to both cognitive deficit of pure DL, and some measured successes of boosting DL by pre-understood cognitive constructs. Finally, our work refutes an overoptimistic conjecture on the number sense of AI models.

BIOGRAPHY

Xiaolin Wu, BSc (Wuhan University, 1982), Ph.D (University of Calgary, 1988). Dr. Wu started his academic career in 1988, and has since been on the faculty of Western University, New York Polytechnic University (NYU Poly), and currently McMaster University where he holds an NSERC senior industrial research chair. His research interests include image processing, computer vision, multimedia signal coding and communication. He has published over two hundred-sixty research papers and holds five patents in these fields. Dr. Wu is an IEEE fellow, serves on IEEE Industrial Digital Signal Processing Committee, on IEEE Multidimensional Signal Processing Committee, and on the technical committees of many IEEE international conferences/workshops. He is McMaster Distinguished Engineering Professor and an associated editor of IEEE Transactions on Image Processing.

All are welcome!

In case of questions, please contact Dr. David HOU at jh.hou@cityu.edu.hk, or visit the CS Departmental Seminar Web at https://www.cs.cityu.edu.hk/events/cs-seminars/recent-cs-colloquiums.