ICONIP-23 Tutorial

Conscious Learning by Developmental Networks: Vision, Audition, Natural Languages, Planning and Thinking

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Keywords: machine learning, strong AI, consciousness, brain models, neural networks, robotics, vision, audition, natural language, APFGP (Autonomous Programing for General Purposes), planning, machine thinking

Suggested duration: Full day (6 hours)

Description of the Tutorial:

Autonomous development needs a general-purpose theory and experimental studies require such a theory. Toward general-purposes, consciousness seems not a wishful add-on to intelligence, but instead a necessary condition to acquire intelligence. Unfortunately, consciousness has been largely overlooked or dodged in AI research. This situation resulted in a major weakness in many neural networks for developmental AI. Without partial consciousness on the fly, the learner, from infants to adults, is not able to generate required context and intents for processing each current sensory and hidden input. This tutorial will teach basic knowledge about biologically inspired neural networks that enables on-the-fly learning for the three bottleneck problems in AI, Vision, Audition, Natural Languages, plus subjects that have been extremely challenging for neutral networks but are necessary, such as planning and machine thinking. All these subjects are essential for conscious learning. More updated detail of Conscious Learning is available at https://doi.org/10.21203/rs.3.rs-1700782/v2

Tutorial outline:

This tutorial first briefly explains what a Turing machine is, what a UTM is, why a UTM is a general-purpose computer, and why Turing machines and UTMs are all symbolic and handcrafted for a specific task. In contrast, a Developmental AI system must program itself through lifetime, instead of being programmed for a specific task. The Developmental Network (DN) by Weng et al. is a new kind of neural network that avoided the controversial Post Selection---selection of networks after they have been trained. A DN learns to become a general-purpose computer by learning an emergent UTM directly from the physical world, like a human child does. Because of this fundamental capability, a UTM inside a DN emerges autonomously on the fly, realizing APFGP (Autonomous Programming For General Purposes), 3D-to-2D-to-3D conscious learning and machine thinking. 3D-to-2D-to-3D means from the 3D world, to 2D images and 2D muscle actions, and back to the 3D world. The well-known three bottleneck problems in AI, vision, audition, and natural language understanding are all naturally dealt with in DN experiments to be presented in the tutorial, including planning and machine thinking. Consciousness is a summation of all such skills and is necessary to acquire intelligence.

History:

A similar tutorial was given at ICDL 2022, IJCNN 2020, ICDL 2020, MFI 2021, ICCE 2022 and IJCNN 2017. IJCNN 2017 was an in-person tutorial with the room fully backed. Without more seats, many participants stood against sidewalls and back walls. The number of participants was around 50.

Estimated number of participants: 50.

Prerequisite knowledge: general knowledge about AI and machine learning. Target audience and interested groups: Professors, industrial researchers, practitioners, post doctorial researchers, graduate students, AI writers, news reporters, government AI policy makers, AI philosophers, and AI fans.

Contents:

1. Autonomous Development by Robots and Animals
2. Turing machines as special purpose machines
3. Variations of Turing machines
4. Universal Turing machines as general purpose machines
5. The control of any Turing machine is a finite automaton
6. Developmental Networks in Contrast with Deep Learning
7. Theorems of Developmental Networks: optimal with limited resource
8. How universal Turing machines emerge inside a DN
9. Vision
10. Audition
11. Natural language understanding
12. Autonomous Programming for General Purposes (APFGP)
13. Conscious AI and 3D-to-2D-to-3D conscious machine learning

Short Biographies of Presenter:

Prof. Juyang Weng is a Life Fellow of IEEE. He received the BS degree from Fudan University, in 1982, M. Sc. and PhD degrees from the University of Illinois at Urbana-Champaign, in 1985 and 1989, respectively, all in computer science. He is a former faculty member of Department of Computer Science and Engineering, faculty member of the Cognitive Science Program, and faculty member of the Neuroscience Program at Michigan State University, East Lansing. He was a visiting professor at the Computer Science School of Fudan University, Nov. 2003 - March 2014, and did sabbatical research at MIT, at Media Lab Fall 1999 – Spring 2000; and at Department of Brain and Cognitive Science Fall 2006-Spring 2007 and taught BCS9.915/EECS6.887 Computational Cognitive and Neural Development during Spring 2007. Since the work of Cresceptron (ICCV 1993) the first deep learning neural networks for 3D world

without post-selection misconduct, he expanded his research interests in biologically inspired systems to developmental learning, including perception, cognition, behaviors, motivation, machine thinking, and conscious learning models. He has published over 300 research articles on related subjects, including task muddiness, intelligence metrics, brain-mind architectures, emergent Turing machines, autonomous programing for general purposes (APFGP), Post-Selection flaws in "deep learning", vision, audition, touch, attention, detection, recognition, autonomous navigation, and natural language understanding. He published with T. S. Huang and N. Ahuja a research monograph titled *Motion and Structure from Image Sequences*. He authored a book titled *Natural and Artificial Intelligence: Computational Introduction to Computational Brain-Mind*. Dr. Weng is an Editor-in-Chief of the *International Journal of Humanoid Robotics*, the Editor-in-Chief of the *Brain-Mind Magazine*, and an associate editor of the *IEEE Transactions on Autonomous Mental Development* (now Cognitive and Developmental Systems). With others' support, he initiated the series of *International Conference on Development and Learning* (ICDL), the *IEEE Transactions on Autonomous Mental Development*, the Brain-Mind Institute, and the startup GENISAMA LLC. He was an associate editor of the *IEEE Transactions on Pattern Recognition and Machine Intelligence* and the *IEEE Transactions on Image Processing*. Web: http://www.cse.msu.edu/~weng/