On the Emergence of Abstract Sciences and Breakthroughs in Machine Knowledge Learning

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Abstract — Recent basic studies have revealed an unprecedented phenomenon of the emergence of *Abstract Sciences* (AS) [Wang & Tunstel, 2019] as a counterpart of classic concrete sciences. AS encompasses contemporary disciplines of data, information, knowledge, intelligence, mathematics, and system sciences. AS leads to novel theories and technologies for AI in general, and Machine Knowledge Learning (MKL) in particular [Wang, 2016]. The latest discovery in AS reveals that the basic unit of knowledge is a *binary relation* (*bir*) [Wang, 2017] as that of *bit* for information and data. MKL powered by the breakthroughs in Cognitive Knowledge Bases (CKB) and denotational mathematics will enhance human learning capability. MKL leads to advanced form of machine learning, which enables cognitive machines as an indispensable assistant to humans with mutually sharable knowledge bases towards collective knowledge learning. A wide range of novel applications in AI and cognitive systems will be presented.

Keywords — Cognitive informatics, abstract sciences, cognitive systems, machine knowledge learning, denotational mathematics, cognitive computing, semantic computing, cognitive knowledge base, applications

ABOUT THE KEYNOTE SPEAKER

Yingxu Wang is professor of cognitive informatics, brain science, software science, and denotational mathematics. He is President of International Institute of Cognitive Informatics and Cognitive Computing (http://www.ucalgary.ca/icic/). He is Fellow of BCS, ICIC and WIF, P.Eng, and Senior Members of IEEE and ACM. He has held visiting professor positions at Oxford University (1995), Stanford University (2008 | 2016), UC Berkeley (2008), and MIT (2012), respectively. He is a member of the Academic Committee of the Beijing State Research Center for Information Science and Technology at Tsinghua Univ. He received a PhD in Computer Science from the Nottingham Trent University, UK, in 1998 and has been a full professor since 1994. He is the founder and steering committee chair of the annual IEEE International Conference on Cognitive Informatics and Cognitive Computing (ICCI*CC) since 2002. He is founding Editor-in-Chiefs of Int'l Journal of Cognitive Informatics & Natural Intelligence, of Software Science & Computational Intelligence, and of Mathematical & Computational Methods. He is Associate Editor of IEEE Trans. on Cognitive and Development Systems (TCDS) and IEEE Computer Society Representative to the steering committee of TCDS. Chair of IEEE SMCS TC-BCS on Brain-inspired Cognitive Systems.

Dr. Wang is recognized by Google search as the initiator of a few cutting-edge research fields including those of cognitive informatics, denotational mathematics (i.e., concept algebra, process algebra, system algebra, semantic algebra, big data algebra, and visual semantic algebra), abstract intelligence (aI), the 3rd generation of information theory in the kowledge space, the spike frequency modulation (SFM) theory, mathematical modeling of the brain, cognitive computing systems, cognitive learning engines, and the cognitive knowledge base theory. His basic studies have acrossed contemporary disciplines of sciences including intelligence, robotics, knowledge, computer, information, brain, cognition, software, data, neurology, linguistics, and system sciences. He has created and proven 100+ theorems in the aforementioned fileds. He has published 500+ peer reviewed papers and 36 books. He has presented 48 invited keynote speeches in international conferences. He has served as honorary, general, and program chairs for 32+ international conferences. He has led 10+ international, European, and Canadian research projects as PI by intensive collaborations with renowned peers and leading industrial partners. He is a top 2.5% scholar worldwide according to Research Gate's international big-data benchmarks.