Pattern Recognition by Inductive Learning Theories for Machine Knowledge Acquisition and Intelligence Generation

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Abstract

According to formal machine learning and autonomous intelligence generation theories, an *abstract pattern* is a generic structure and/or function inductively elicited from a variety of instances in intelligent systems [1] – [4]. It is recognized that pattern recognition is one of the six fundamental methodologies for machine learning [5] – [23] in intelligence science [24] – [31] encompassing *object identification*, *cluster classification*, *pattern recognition*, *functional regression*, *knowledge acquisition*, and *intelligence generation* [13], [14], Towards the development of a theoretical framework of patterns, fundamental queries have been raised on those: a) Is there a general mathematical pattern of patterns; and b) How do patterns be inductively created based on a sufficiently small set of samples mimicking human intelligence beyond exhaustive data-driven machine learning in traditional intelligent systems? These fundamental questions are addressed by basic research in *Intelligent Mathematics* (IM) [32] – [42] that leads to a generic treatment of AI and inductive pattern modeling by *autonomous intelligence* (ΛI) [1], [2], [24], [25], [28]. Powered by ΛI and IMs, pattern recognitions by inductive learning and causal inferences are elaborated by *concept algebra* [35], *inference algebra* [36], [43], and *real-time process algebra* (RTPA) [37], etc.

This keynote lecture presents a formal pattern recognition framework underpinned by the inductive learning theory towards advanced machine knowledge acquisition and intelligence generation. It reveals the cognitive mechanisms and processes of pattern recognitions by inductive machine learning. A mathematical model of general patterns is introduced based on IMs. Applications of formal pattern recognitions and elicitations will be demonstrated in intelligent systems, cognitive systems, autonomous systems, image recognitions, software systems, and cognitive robots.

***Keywords* —** AI, pattern recognition, intelligent science, intelligent systems, autonomous systems, inductively reasoning, cognitive robots, machine learning, intelligent mathematics, brain-inspired systems

About the Keynote Speaker

Dr. Yingxu Wang, FIEEE, FBCS, FI2CICC, FAAIA, and FWIF, is professor of cognitive systems, brain science, software science, and intelligent mathematics. He is the founding President of International Institute of Cognitive Informatics and Cognitive Computing (I2CICC). He has held visiting professor positions at Univ. of Oxford (1995, 2018-2022), Stanford Univ. (2008, 2016), UC Berkeley (2008), MIT (2012), and distinguished visiting professor at Tsinghua Univ. (2019-2022). 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 IEEE Int'l Conference Series on Cognitive Informatics and Cognitive Computing (ICCI*CC) since 2002. He is founding Editor-in-Chiefs and Associate Editors of 10+ Int'l Journals and IEEE Transactions. He is Chair of IEEE SMCS TC-BCS on Brain-inspired Cognitive Systems, and Co-Chair of IEEE CS TC-CLS on Computational Life Science. His basic research has been across contemporary science disciplines of intelligence, mathematics, knowledge, robotics, computer, information, brain, cognition, software, data, systems, cybernetics, neurology, and linguistics. He has published 600+ peer reviewed papers and 38 books/proceedings. He has presented 60+ invited keynote speeches in international conferences. He has served as honorary, general, and program chairs for 40 international conferences. He has led 10+ international, European, and Canadian research projects as PI. He is recognized by Google Scholar as world top 1 in Software Science, top 1 in Cognitive Robots, top 7 in Autonomous Systems, top 2 in Cognitive Computing, and top 1 in Knowledge Science with a *h*-index 59. He is recognized by Research Gate as among the world's top 2.5% scholars with a remarkable readership record of 481,600+.

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