Chapter 5

Abstract Intelligence:
Embodying and Enabling Cognitive Systems by Mathematical Engineering

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ABSTRACT

*Basic studies in denotational mathematics and mathematical engineering have led to the theory of abstract intelligence (aI), which is a set of mathematical models of natural and computational intelligence in cognitive informatics (CI) and cognitive computing (CC). Abstract intelligence triggers the recent breakthroughs in cognitive systems such as cognitive computers, cognitive robots, cognitive neural networks, and cognitive learning. This paper reports a set of position statements presented in the plenary panel (Part II) of IEEE ICCI*CC'16 on Cognitive Informatics and Cognitive Computing at Stanford University. The summary is contributed by invited panelists who are part of the world's renowned scholars in the transdisciplinary field of CI and CC.*

1. INTRODUCTION

Cognitive Informatics (CI) is a transdisciplinary enquiry of the internal information processing mechanisms and processes of the brain and abstract intelligence, as well as their applications in cognitive computing and cognitive engineering (Wang, 2002, 2003, 2006, 2007a; Wang et al., 2002, 2009b, 2010). CI is a contemporary field spanning across computer science, information science, cognitive science, brain science, neuroscience, intelligence science, knowledge science, robotics, cognitive linguistics, cognitive philosophy, and cognitive engineering. *Cognitive Computing* (CC) is a novel paradigm of intelligent computing platforms of cognitive methodologies and systems based on CI, which embodying computational intelligence by cognitive and autonomous systems mimicking the mechanisms of the brain (Wang, 2011b, 2012e, 2015b, 2016a; Wang et al., 2006). IEEE ICCI*CC'16 on Cognitive Informatics and Cognitive Computing has been held at Stanford University during Aug. 22-23, 2016. The theme of ICCI*CC'16 was on cognitive computing, big data cognition, and machine learning (Widrow, 2016; Zadeh, 2016; Wang et al., 2016b).

CI and CC emerged from transdisciplinary studies in both natural intelligence in cognitive/brain sciences (Anderson, 1983; Sternberg, 1998; Reisberg, 2001; Wilson & Keil, 2001; Wang, 2002, 2007a; Wang et al., 2002, 2008, 2009, 2016) and artificial intelligence in computer science (Bender, 1996; Poole et al., 1997; Zadeh, 1999; Widrow et al., 2015; Wang, 2010a, 2016c). Towards formal explanation of the structures and functions of the brain, as well as their intricate relations and interactions, formal models are sought for revealing the principles and mechanisms of the brain. This leads to the theory of abstract intelligence (αI) that investigates into the brain via not only inductive syntheses of theories and principles of intelligence science through mathematical engineering, but also deductive analyses of architectural and behavioral instances of natural and artificial intelligent systems through cognitive engineering. The key methodology suitable for dealing with the nature of αI is mathematical engineering (ME), which is an emerging discipline of contemporary engineering that studies the formal structural models and functions of complex abstract and mental objects and their systematic and rigorous manipulations (Wang, 2015a).

This paper is a summary of the position statements of invited panellists presented in the *Plenary Panel on Perspectives on Cognitive Computing, Big Data Cognition, and Machine Learning* (Part II), which was held in IEEE ICCI*CC 2016 (Wang et al., 2016b/c) at Stanford University, USA, on Aug. 23, 2016. It is noteworthy that the individual statements and opinions included in this paper may not necessarily be shared by all panellists.

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