Chapter 84
Cognitive Intelligence: Deep Learning, Thinking, and Reasoning by Brain-Inspired Systems

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ABSTRACT

*The theme of IEEE ICCI*CC'16 on Cognitive Informatics (CI) and Cognitive Computing (CC) was on cognitive computers, big data cognition, and machine learning. CI and CC are a contemporary field not only for basic studies on the brain, computational intelligence theories, and denotational mathematics, but also for engineering applications in cognitive systems towards deep learning, deep thinking, and deep reasoning. This paper reports a set of position statements presented in the plenary panel (Part I) in IEEE ICCI*CC'16 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, 2002a, 2003, 2006, 2007a; Wang et al., 2002, 2009a/b, 2010, 2011a). 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, 2009b, 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).

The IEEE series of *International Conferences on Cognitive Informatics and Cognitive Computing* (ICCI*CC) has been established since 2002 (Wang, 2002a). The inaugural ICCI event in 2002 was held at University of Calgary, Canada (ICCI'02) (Wang et al., 2002), followed by ICCI'03 in London, UK (Patel et al., 2003); ICCI'04 in Victoria, Canada (Chan et al., 2004); ICCI'05 in Irvine, USA (Kinsner et al., 2005); ICCI'06 in Beijing, China (Yao et al., 2006); ICCI'07 in Lake Tahoe, USA (Zhang et al., 2007); ICCI'08 at Stanford University, USA (Wang et al., 2008); ICCI'09 in Hong Kong (Baciu et al., 2009); ICCI'10 at Tsinghua University, Beijing, China (Sun et al., 2010); ICCI*CC'11 in Banff, Canada (Wang et al., 2011a); ICCI*CC'12 in Kyoto, Japan (Sugawara et al., 2012), ICCI*CC'13 in New York, USA (Hsu et al., 2013), ICCI*CC'14 in London, UK (Patel et al., 2014), ICCI*CC'15 at Tsinghua University, Beijing, China (Ge et al., 2012), and ICCI*CC'16 at Stanford University, USA (Wang et al., 2016). Since its inception, the ICCI*CC series has been growing steadily in its size, scope, and depth. It has attracted worldwide researchers from academia, government agencies, and industry practitioners. The conference series provides a main forum for the exchange and cross-fertilization of ideas in the new research field of CI toward revealing the cognitive mechanisms and processes of human information processing and the approaches to mimic them in cognitive computing. A wide range of breakthroughs have been recognized and a wide range of applications has been developed in CI and CC in the last decade. The representative paradigms and technologies developed in cognitive informatics include cognitive computers, abstract intelligence, cognitive learning engines, cognitive knowledge bases, denotational mathematics, and applied cognitive systems.