Perspectives on Cognitive Computers and Knowledge Processors

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ABSTRACT

Cognitive Informatics (CI) is a contemporary multidisciplinary field spanning across computer science, information science, cognitive science, brain science, intelligence science, knowledge science, cognitive linguistics, and cognitive philosophy. CI aims to investigate the internal information processing mechanisms and processes of the brain, the underlying abstract intelligence theories and denotational mathematics, and their engineering applications in cognitive computing and computational intelligence. This paper reports a set of

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*eleven position statements presented in the plenary panel of IEEE ICCI*CC'13 on Cognitive Computers and Knowledge Processors contributed from invited panelists who are part of the world's renowned researchers and scholars in the field of cognitive informatics and cognitive computing.*

Keywords: *Artificial Intelligence, Cognitive Computing, Cognitive Informatics (CI), Cognitive Robots, Concept Algebra, Denotational Mathematics, eBrain, Knowledge Processors, Natural Intelligence, Visual Semantic Algebra*

1. INTRODUCTION

The theme of the 2013 IEEE International Conferences on Cognitive Informatics and Cognitive Computing (ICCI*CC'13) is on *Cognitive Computers* and *Knowledge Processors*. *Cognitive Informatics* (CI) is a transdisciplinary enquiry of computer science, information science, cognitive science, and intelligence science that investigates into the internal information processing mechanisms and processes of the brain and natural intelligence, as well as their engineering applications in cognitive computing (Wang, 2002a, 2003, 2006, 2007b, 2007c, 2007d, 2009a, 2009b, 2012c, 2012d, 2012f; Wang et al., 2011c, 2013; Wang and Kinsner, 2006; Wang and Wang, 2006; Wang and Berwick, 2012b; Wang et al., 2009b, 2009c, 2010, 2011b).

Fundamental theories developed in CI cover the *Matter-Energy-Information-Intelligence* (MEII) model (Wang, 2007a, 2007b), the *Layered Reference Model of the Brain* (LRMB) (Wang et al., 2006), the *Object-Attribute-Relation* (OAR) model of internal information representation in the brain (Wang, 2007c), the *Cognitive Functional Model of the Brain* (CFMB) (Wang & Wang, 2006), the *Abstract Intelligence Model of the Brain* (AIMB), *Natural Intelligence* (Wang, 2007b), *Abstract Intelligence* (Wang, 2009a, 2012c), *Neuroinformatics* (Wang, 2007b, 2013a, 2013b; Wang & Fariello, 2012a), *Denotational Mathematics* (Wang, 2002b, 2007a, 2008a, 2008b, 2008c, 2008d, 2009d, 2011a, 2011b, 2012a, 2012b, 2012e, 2012g, 2013c), *Cognitive Linguistics* (Wang & Berwick, 2012b; Wang, 2013d; Wang et al., 2012d), *Formal Neural Signal and Circuit Theories* (Wang & Fariello, 2012a), *Cognitive Systems* (Kinsner, 2011; Wang, 2010b, 2011c; Wang et al., 2011c, 2013). Recent studies on LRMB in cognitive informatics reveal an entire set of cognitive functions of the brain and their cognitive process models, which explain the functional mechanisms and cognitive processes of the natural intelligence with 48 cognitive processes at seven layers known as the sensation, action, memory, perception, meta-cognitive, inference, and advanced cognitive layers (Wang et al., 2006).

Cognitive Computing (CC) is a novel paradigm of intelligent computing methodologies and systems based on CI that implements computational intelligence by autonomous inferences and perceptions mimicking the mechanisms of the brain (Wang, 2006, 2009b, 2009c, 2010a, 2012b; Wang et al, 2011d). CC is emerged and developed based on the multidisciplinary research in CI, abstract intelligence, and denotational mathematics (Wang, 2009a, 2012c). Recent paradigms of cognitive computers are such as *cognitive robots* (Wang, 2010b) and *cognitive learning engines* (Wang & Tian, 2013; Wang et al., 2011c; Tian et al., 2011).

The latest advances in CI and CC, as well as denotational mathematics, enable a systematic solution for the future generation of intelligent computers known as *cognitive computers* (CogCs) that think, perceive, inference, and learn (Wang, 2006, 2009b, 2010a, 2010b, 2012b, 2012h). A CogC is an intelligent computer for knowledge processing as that of a conventional von Neumann computer for data processing. CogCs are designed to embody *machinable intelligence* such as computational inferences, causal analyses, knowledge manipulation, machine learning, and autonomous problem solving. Recent studies in cognitive computing reveal that the computing power in computational intelligence can be classified at