# Chapter 1
# Perspectives on Cognitive Informatics and Cognitive Computing

**Yingxu Wang**
*University of Calgary, Canada*

**George Baciu**
*The Hong Kong Polytechnic University, Hong Kong*

**Yiyu Yao**
*University of Regina, Canada*

**Witold Kinsner**
*University of Manitoba, Canada*

**Keith Chan**
*The Hong Kong Polytechnic University, Hong Kong*

**Bo Zhang**
*Tsinghua University, China*

**Stuart Hameroff**
*The University of Arizona, USA*

**Ning Zhong**
*Maebashi Institute of Technology, Japan*

**Chu-Ren Hunag**
*The Hong Kong Polytechnic University, Hong Kong*

**Ben Goertzel**
*Novamente LLC, USA*

**Duoqian Miao**
*Tongji University, China*

**Kenji Sugawara**
*Chiba Institute of Technology, Japan*

**Guoyin Wang**
*Chongqing Posts and Telecommunications University, China*

**Jane You**
*The Hong Kong Polytechnic University, Hong Kong*

**Du Zhang**
*California State University - Sacramento, USA*

**Haibin Zhu**
*Nipissing University, Canada*

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## ABSTRACT

*Cognitive informatics is a transdisciplinary enquiry of computer science, information sciences, cognitive science, and intelligence science that investigates the internal information processing mechanisms and processes of the brain and natural intelligence, as well as their engineering applications in cognitive computing. Cognitive computing is an emerging paradigm of intelligent computing methodologies and systems based on cognitive informatics that implements computational intelligence by autonomous inferences and perceptions mimicking the mechanisms of the brain. This article presents a set of collective perspectives on cognitive informatics and cognitive computing, as well as their applications in abstract intelligence, computational intelligence, computational linguistics, knowledge representation, symbiotic computing, granular computing, semantic computing, machine learning, and social computing.*

## INTRODUCTION

**Definition 1:** *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, 2003a, 2003b, 2004, 2005, 2007b, 2008b, 2009a; Wang & Kinsner, 2007; Wang & Wang, 2006; Wang, Kinsner, & Zhang, 2009a, 2009b; Wang et al., 2006, 2009).*

The latest advances and engineering applications of CI have led to the emergence of cognitive computing and the development of cognitive computer that think and learn, as well as autonomous agent systems.

**Definition 2:** *Cognitive Computing (CC) is an emerging paradigm of intelligent computing methodologies and systems based on cognitive informatics that implements computational intelligence by autonomous inferences and perceptions mimicking the mechanisms of the brain (Wang, 2002a, 2009b, 2009g).*

CC is emerged and developed based on the transdisciplinary research in cognitive informatics, abstract intelligence, and denotational mathematics since the inauguration of the 1st IEEE International Conference on Cognitive Informatics (ICCI 2002, see Figure 1) (Wang et al., 2002, 2008).

**Definition 3:** *Abstract Intelligence (αI) is the general mathematical form of intelligence as a natural mechanism that transfers information into behaviors and knowledge (Wang, 2009a).*

Typical paradigms of αI are natural intelligence, artificial intelligence, machinable intelligence, and computational intelligence, as well as their hybrid forms.

**Definition 4:** *Denotational Mathematics (DM) is a category of expressive mathematical structures that deals with high-level mathematical entities beyond numbers and sets, such as abstract objects, complex relations, perceptual information, abstract concepts, knowledge, intelligent behaviors, behavioral processes, and systems (Wang, 2002b, 2007a, 2008a, 2008c, 2008d, 2008e, 2009d, 2009f; Wang, Zadeh & Yao, 2009).*

In recognizing mathematics as the *meta-methodology* of all sciences and engineering disciplines, a set of DMs have been created and applied in CI, αI, CC, AI, soft computing, computational intelligence, and fuzzy inferences.

The IEEE ICCI series has been established since 2002 (Wang, 2002a, 2003b; Wang et al.,

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