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EDITORIAL

Renewal of the Major Fields

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Upon the retirement of two area editors, Toyoaki Nishida and Akihiko Konagaya, we are happy to introduce three new area editors, Ryutaro Ichise, Ferdinand Peper, and Satoshi Murata. Ichise succeeds Nishida and continues to handle the major field "Cognitive Computing" though the topics of the field slightly change due to the expertise of Ichise. Peper and Murata succeed Konagaya, who has been handling the major field "Biocomputing." Since the field of Peper and that of Murata overlap, papers mainly dealing with theoretical models will be handled by Peper while papers touching upon physical or chemical implementation will be handled by Murata. The description of the new major fields follows this short introduction.

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Cognitive Computing

The area "Cognitive Computing" in New Generation Computing started in 2014. There is no clear definition of cognitive computing yet, but we treated this area as being "human-oriented computing for building human-centered systems." We are expanding this idea into "making a computational model of human cognition" for all new submissions.

Human cognition has several aspects, including acquiring knowledge, reasoning, problem solving, and decision making. We still have many open research questions on these topics, for example, in knowledge acquisition, questions on representation of knowledge, learning from data, and usage of learned knowledge, among others, remain. To model human cognition computationally, many techniques need to be developed. Our focus in the area "Cognitive Computing" is the creation of such computational models.

Furthermore, since human cognition is not an isolated element but rather an integrated process, research on an integrated platform across cognitive elements is necessary. This topic includes research on cognitive architecture and artificial general intelligence. We encourage submissions of research papers on such domains, as well, in the area "Cognitive Computing."

We welcome submissions of a wide range of research papers for implementing human cognitive processes as a computational model. This research area includes the following topics.

- Modeling human knowledge
- Modeling human problem solving and learning
- Modeling and analyzing decision making
- Cognitive architecture
- Artificial general intelligence
- Human level AI

However, these are just examples, and this area is not limited to only these topics.

Area Editor Ryutaro Ichise
National Institute of Informatics

Control Theory of Bio- and Nano-systems

With the development of ever more advanced engineered bio- and nano-systems, there is an increasing need to control phenomena on molecular scales. Though direct control by a human operator has become feasible through the development of equipment like the scanning tunneling microscope and the atomic force microscope, it is a great challenge to realize more indirect control in which bio- and nano-systems display a certain degree of intelligence and are able to autonomously run their course for an extended period of time according to a human-defined procedure.

Bio- and nano-systems tend to use signals that have a discrete character. Single particles are the most extreme form of such signals, and they find their equivalents

in computer science in the form of token-based circuits, like Petri nets. These models, however, need reconsideration, because they fall short in describing various phenomena commonly found on molecular scales, like Brownian motion, which has been shown to be a remarkable resource for stochastic search in computation. The brain offers another example of a radically different framework, in which signals take the form of impulses called *spikes*.

Nature offers fascinating examples of information representation and processing that have hardly been touched upon from the perspective of computer science. This area in New Generation Computing invites papers that seek to develop this topic ranging from an abstract, formal, point of view to the practical implementation level.

Examples of topics are listed below, but are not limited to:

- Formal models of molecular systems
- Computation by token-based systems: systems in nature that use interactions between particles to conduct computation, self-organization, or other operations
- Non-boolean representations of signals in nature, including representations by collections of particles or impulses, and methods to conduct information processing using such signals
- Cellular automata based on mechanisms found in nature

Area Editor Ferdinand Peper
NICT-CiNet

Bio/Nano/Molecular Computing and Engineering

Bioscience, nanotechnology and molecular technology are acceleratingly advanced in these days. A variety of new principles have been found one after another, and new technologies have been developed based on them. There are many interesting results from the viewpoint of computer science or computer engineering and investigating them is expected to lead to the new generation principles of computation and the new generation applications of computer science.

In "Bio/Nano/Molecular Computing and Engineering," we are looking for papers dealing with various novel computing principles and their engineering applications on the premise that they are based on some physical, chemical or biological substances.

Topics of interest include bio-inspired computing, computing based on biological principles, computing based on nano/molecular level physics/chemistry, and methodologies of system construction based on them. We welcome theoretical, conceptual, simulation and experimental studies.

Examples of topics are listed below, but are not limited to:

- Molecular robotics & artificial cells: building autonomous systems with designed molecules and molecular devices
- DNA nanoengineering: building computing systems and other applications using programmable macromolecules such as DNA/RNA/peptide as materials

– Molecular computing/programming: designing molecular-level reactions to realize various levels of autonomy and intelligence
– Self-organizing systems: investigating emergence of order in artificial and natural systems based on chemical/physical/biological interactions

Area Editor Satoshi Murata
Tohoku University

The last renewal of the major fields and the definitions of the four major fields below are detailed in the announcement [1].

– Programming and semantics
– Social computing
– Data mining
– Learning

Reference

1. Hagiya, M., Ueda, K., et al.: Renewal of the major fields from New Generation Computing Vol. 32 (2014). New Gener. Comput. **32**(1), 1–7 (2014)