Complexity

Special Issue on
Complexity in Emergent and Distributed Systems: A Logical View

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CALL FOR PAPERS

In analyzing complex adaptive systems, there can be classical as well as nonclassical approaches. The most basic notion of classical approach implicitly used in modelling different natural or societal systems is presented by algorithms presupposing the induction principle.

Nevertheless, in analyzing phenomena of self-organization and emergence, the classical treatment of an algorithm is unapplied. The point is that self-organized (emergent) and distributed systems containing loops and self-references cannot have a single centralized source exercising precise control over vast numbers of heterogeneous subsystems. Instead of induction, one applies there coinduction as a type of operation that is dual to induction.

Coinduction is typically used to generate infinite data structures called codata. The rule for primitive corecursion on codata is dual to that for primitive recursion on data. Instead of descending on the argument, we ascend on the result. Notice that corecursion creates potentially infinite codata, whereas ordinary recursion analyzes necessarily finite data.

Recently many researchers have focused on the idea that we cannot avoid coinductive notions, such as process dynamics, behavioural instability, self-reference, or circularity, in analyzing complexity. All these researches modelling natural or societal systems via coinductive logical tools form a novel computational paradigm with much potential.

The methodological framework of this paradigm is represented by the following nonclassical logics: non-well-founded set theory, situation semantics, non-Archimedean probability logics, p-adic valued logics, coalgebra, hidden algebra, and so forth.

The aim of this special issue is to analyze new methodologies involved in studying complexity. We are going to bring together computer scientists and engineers dealing with complexity practically with mathematicians and logicians dealing with nonclassical logical, algebraic, coalgebraic, topological, and category-theoretic methods to initiate development of novel bio- and nature-inspired computation paradigms for modelling emergent and distributed systems.

Potential topics include but are not limited to the following:

- Theoretical results
  - Cellular automata
  - Computational complexity
  - Large-scale parallel computing
  - Neural networks
  - Parallel programming languages
  - Behavioural logic
  - Tree logic
  - Spatial logic
  - Coinductive logic
  - Concurrent games
  - Infinite games
- Practical results with nonclassical methodologies
  - Swarm computing
  - Social insects computing
  - Chaotic computing
  - Ad hoc and sensor wireless network
  - Cloud Computing
  - Bio-molecular computing
  - Logics of unconventional computing
  - Computational models of cognition
  - Logical methods of behavioural economics
  - Social Networks

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