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ENECC @ ICSE 2018 Entering a New Era of Cognitive Computing. Unifying Old Computing Models and Current Artificial Intelligence, Machine Learning, Deep Learning and Natural Computing

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Entering a New Era of Cognitive Computing.

Unifying Old Computing Models and Current Artificial Intelligence, Machine Learning, Deep Learning and Natural Computing

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ABSTRACT

Nature-inspired computational technologies are gaining remarkable success these days, such as Deep Learning that found its inspiration in the learning in neural networks of the human brain. In order to solve the problem of control, maintenance and repair of huge and complex computational systems emerging with new technologies of Internet Of Things, Big Data, Cloud Computing, Cyber-physical systems, Augmented Reality and similar, one needs to look not only at the function of the brain, but also at the function of the whole living organism in interaction with the environment – the process known as cognition. The novel field of cognitive computing holds promise of providing solutions inspired by nature for solving the problem of the control and maintenance of future computing systems. This workshop aims to present and explore potential of cognitive computing through a combination of invited papers given by experts, contributed papers, panel- and plenary discussions.

CCS CONCEPTS

Computing methodologies → **Cognitive science** • **Computer systems organization** → Distributed architectures

KEYWORDS

Cognitive computing, Distributed computing, Natural computing

1 Workshop organization

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2 Motivation and Objectives

2.1 Relevance of the workshop

Digitalisation of society comes with variety of new emerging technologies such as Internet Of Things, Big Data, Cloud Computing, Cyber-physical systems, Augmented Reality and more. New ubiquitous computing necessitates management and control of computational networks of networks of unprecedented complexity in a smooth, reliable and automated way. It is known since time of von Neumann that traditional computing machinery lacks resilience and ability to tackle complex and uncertain circumstances. In order to confront problems of automatic control and maintenance, living systems have become a source of inspiration for the development of computational devices and processes that possess adaptability, resilience and self-healing properties.

Todays' computing has evolved to execute very complex algorithms by processing multitudes of data streams, which creates new representations i.e. the knowledge of the system. The algorithms are designed to address the evolution of data. While the "intent" of the algorithm is well defined in terms of a sequence of steps, the resources and the time required for executing the intent depends on many factors outside the specification and scope of the algorithm itself. Computing resources such as the speed and memory determine the outcome of the execution. The nature of the algorithm also dictates the resources required. Whereas current day hardware and software architectures implement complex algorithms to model physical systems, to reason about them and exercise control over them, the optimization of the resources to improve the efficiency is independent of the power of the algorithm. Mark Burgin in his book Super-Recursive Algorithms [1] emphasizes that "efficiency of an algorithm depends on two parameters: power of the algorithm and the resources that are used in the process of solution. If the algorithm does not have necessary resources, it cannot solve the problem under consideration." The computing resources required for the computation depend both on their availability in terms of CPU, memory, network bandwidth,

latency, storage capacity, IOPs and throughput characteristics of the hardware, and on the nature of the algorithm (the software). The efficiency of execution of the computation depends upon managing the dynamic relationship of the hardware and the software to monitor the fluctuations and adjusting the resources to execute the computation.

The experience of a new software architecture (Distributed Intelligent Managed Element - DIME) that have been developed to use the meta-model of the computation and the knowledge about available resources to monitor and manage the computation workflow, is presented in the book Designing a New Class of Distributed Systems [2]. The DIME network architecture allows managing the evolution of the computation by adjusting the resources required through constant monitoring and control [3,4].

The connection with the Natural computing paradigm is addressed in [5-7], with computation defined as information processing and studied in living organisms and other natural systems.

2.2 Anticipated goals and outcomes

Novel approaches to computation such as cognitive computing respond to calls for new computing models to address interactive, concurrent dynamic processes [3-11]. We are proposing this workshop to address these and other related approaches to improve the efficiency of computations to meet the challenges of cognitive computing. We believe that introducing elements of cognition into distributed computing systems that makes them "aware" of both the intent and evolution will enable self-managing capabilities. The workshop will bring together experts in software architecture, computing and cognition to discuss and evaluate various approaches to introduce cognition into distributed computing elements. The outcome of the workshop will be an increased shared understanding of challenges and opportunities in distributed computing system architecting by means of self-management by cognitive computing.

3 Workshop format

Workshop format will be a combination of invited papers given by experts, contributed papers breakout sessions and panel discussion. Discussions will follow each presentation; they will be in breakout sessions and in connection with panel.

The sessions will include paper presentations followed by discussions. In addition to these sessions, we will have a keynote and invited speakers. We will also have a concluding, discussion-oriented session.

The list with the invited speakers and keynote candidates

John Pestian, https://www.cincinnatichildrens.org/bio/p/john-pestian

Patrizio Pelliccione, Chalmers University of Technology http://www.patriziopelliccione.com

Kurt Wallnau, Software Engineering Institute, CMU http://www.sei.cmu.edu/about/people/profile.cfm?id=wallnau_13228

Samir Mittal, Micron, CEO and Founder at SCUTI AI

Vipin Tyagi, Board director, C-DoT, India head AI R&D

Luc Dubois, Orange Business Services

Stephane Schwob, Orange Business Services

Giovanni Morana, C3DNA, Italy

Massimo Villari, Professor, University of Messina, Italy https://www.iaria.org/speakers/MassimoVillari.html

Alan Lee, AMD https://www.linkedin.com/in/alan-lee-ceo

Mark Burgin, University California Los Angeles, http://www.math.ucla.edu/~mburgin/

Eugene Eberbach, Rensselaer Polytechnic Institute, http://www.ewp.rpi.edu/hartford/~eberbe/

3.1 Intended length and special services

Intended length of the workshop is 1 day.

We expect No special services, no logistic and/or equipment constraints – standard projector + whiteboard.

3.2 Target Audience

Workshop attendees = ICSE attendees, no special prerequisites. Several of our invited speakers come from industry so workshop will definitely have industrial relevance.

We expect 20-20 participants.

The workshop will be open and we will invite our colleagues, and students and expect other interested ICSE participants.

3.3 Proceedings

The workshop will accept two types of papers: long papers with 8 pages and short papers with 4 pages. The long papers should present the ongoing research, novel ideas with preliminary results, advances of the state of the art, analysis of the current results in state of the art or state of the practice, or experience in implementing some of the theories. The short papers should focus more on novel ideas, some very preliminary results, suggested research directions, and similar.

The papers will be reviewed by at least three reviewers. We use EasyChair as the conference management system.

Program Committee

Mark Burgin, University of California, Los Angeles, USA
Giacomo Cabri University of Modena and Reggio Emilia, Italy
Giuseppe Primiero, Middlesex University London, UK
Mizumachi Hiroaki, NEC, Japan
Eugene Eberbach, Rensselaer Polytechnic Institute, USA
Robert Lowe, Chalmers Technical University, Sweden
Fabrizio Messina, Catania University, Italy
Giovanni Morana, C3DNA, Italy
Gregg Michelson, University of Glasgow, UK
Paul Cockshott, University of Glasgow, UK
Ramana Reddy, West Virginia University, USA
Ramiro Salas, Pivotal, USA
Peter Wegner, Brown University, USA
Fatos Xhafa, Universitat Politècnica de Catalunya, Spain

Kenneth Owens, Cisco, USA
Khelender Sasan, NTI, India
Antonella Di Stefano, University of Catania, Italy
Samir Tata, Professor at Télécom SudParis, France
Stefaneas S. Petros, National Technical University of Athens, Greece
Hector Zenil, University of Oxford and Wolfram Science

3.4 Workshop History

Workshops addressing related topics, organized by Rao Mikkillineni and Gordana Dodig-Crnkovic:

Architecting Self-Managing Distributed Systems Workshop @ ECSA 2015 September, 7th 2015, Dubrovnik/Cavtat, Croatia Organizers: Rao Mikkilineni & Gordana Dodig-Crnkovic http://www.ecsa-conference.org/2015/asds/contact.html

Cognitive distributed computing and its impact on IT as we know it. Symposium at is4si summit 2017, Gothenburg. Organizer: Rao Mikkilineni

http://is4si-2017.org/program/symposia/cognitive-distributed-computing/

Number of registered attendees was about 20 for both.

4 Link to preliminary web site of the workshop

https://sites.google.com/view/enecc

5 Organizers' bios

Rao Mikkilineni

Rao Mikkilineni received his PhD from University of California, San Diego working under the guidance of Professor Walter Kohn (Nobel Laureate 1998). He later worked as a research associate at the University of Paris, Orsay, Courant Institute of Mathematical Sciences, New York and Columbia University, New York. He is currently Co-Founder and Chief Scientist at C3DNA, a Silicon Valley company developing cognitive distributed computing infrastructure. His past experience includes working at AT&T Bell Labs, Bellcore, U S West, several start-ups and more recently Hitachi Data Systems. He currently co-chairs the IEEE conference track on the convergence of distributed clouds, Grids and their management in WETICE. His book "Designing a New Class of Distributed Systems" was published in 2011 by Springer. http://www.amazon.com/Rao-Mikkilineni/e/B0077CLHDI http://c3dna.academia.edu/RaoMikkilineni www.linkedin.com
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Gordana Dodig Crnkovic

Gordana Dodig Crnkovic, Ph.D. is a full professor of computer science, affiliated with Mälardalen University and Chalmers University of Technology, Sweden. Her background is in theoretical physics; she has a degree in computer science. She has published on natural computing/ computing nature with focus on computational approaches to cognition and morphological computing. Her books "Computing Nature" is published by Springer in 2013 and "Representation and Reality in Humans, Other Living Organisms and Intelligent Machines" in 2017 (both co-edited with Raffaela Giovagnoli). Dodig-Crnkovic has organized more than a dozen high international level conferences and workshops. In 2017 she organized major international event, is4si summit on Digitalization for sustainable development https://www.chalmers.se/en/staff/Pages/gordana-dodig-crnkovic.aspx
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Email: dodig@chalmers.se

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B ENECC @ ICSE 2018. Entering a New Era of Cognitive Computing Workshop Draft Call for Submissions

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The talks and the discussions will be organised :

- Evolution of the Turing Machines to autonomous Turing Machines
- Evolution of AI and Machine Learning to Deep Learning
- Introduction of Cognition into Computation and its evolution and
- The convergence of Cognition, Compting models and Communication paradigms in creating distributed intelligent systems

The workshop will accept two types of papers: long papers with 8 pages and short papers with 4 pages. The long papers should present the ongoing research, novel ideas with preliminary results, advances of the state of the art, analysis of the current results in state of the art or state of the practice, or experience in implementing some of the theories. The short papers should focus more on novel ideas, some very preliminary results, suggested research directions, and similar.

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Khelender Sasan, NTI, India
Antonella Di Stefano, University of Catania, Italy
Samir Tata, Professor at Télécom SudParis, France
Stefaneas S. Petros, National Technical University of Athens, Greece
Hector Zenil, University of Oxford and Wolfram Science

We expect papers addressing (but not limited to) the following topics:

- Current limitations and new approaches to self-managing distributed systems
- Improving the efficiency of computations to address resilience, adaptivity, high degree of scaling and large fluctuations
- Adaptive Distributed Cognitive Computing
- Collaborative and Autonomic Cognitive Computing
- Cyber Physical Systems and Cognitive Computing Architectures
- Cognitive Computing Solutions for Software Architecture
- Software Architecture of Cognition and Cognition in Software Architecture
- Cognitive distributed computing systems
- Emerging policies, algorithms and architectural frameworks for Service Level Agreement (SLA) for unified computing infrastructures
- Intelligent systems for deploying and configuration of Clouds and Grid Services
- Emerging infrastructures, middleware, frameworks for Unified computing platforms
- Cognitive systems for unified and federated utility computing infrastructures
- Self-protecting systems - Security, Privacy, Trustworthiness for Public, Private, and Hybrid Clouds

Link to preliminary web site of the workshop: https://sites.google.com/view/enecc