Communications in Computer and Information Science 1068

Commenced Publication in 2007
Founding and Former Series Editors:
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Computational Neuroscience

Second Latin American Workshop, LAWCN 2019
São João Del-Rei, Brazil, September 18–20, 2019
Proceedings

Springer

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ISSN 1865-0929 ISSN 1865-0937 (electronic)
Communications in Computer and Information Science
ISBN 978-3-030-36635-3 ISBN 978-3-030-36636-0 (eBook)
https://doi.org/10.1007/978-3-030-36636-0

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The human brain is the most complex object of the universe known to man. Almost a hundred billion neurons making trillions of synaptic contacts in an astounding number of possible combinations is only one important part of this system, that also includes glia and other cells with multifaceted effects in neural function. This tremendous complexity makes it incredibly challenging to fully understand the nervous system and deliver robust treatment to its dysfunctions – a winning candidate for the ultimate frontier of science. To overcome this immense challenge, a fruitful endeavor is to approach the study of the brain by multi and interdisciplinary science. With the benefit of exponential development in computer sciences and technologies, and also the comprehensive accumulated knowledge on the nuts and bolts of the nervous system, a new era of highly collaborative transdisciplinary science is blooming.

Neuroscientists can now simulate from molecules to neuronal cells, circuits, and maybe the whole brain in *in silico* experiments of computational neuroscience overcoming limitations of *in vivo* and *in vitro* preparations. At the same time, computer science can also benefit from neuroscience by incorporating neurobiological knowledge of how the brain learns and performs cognitive tasks into software and hardware to generate artificial intelligence and machine learning. Finally, the dialogue between the biological milieu and the digital world has enabled the direct communication between brain and machine, making it possible to develop groundbreaking technologies to treat myriad brain disorders and to enhance function, while at the same time giving rise to entire novel biohybrid systems of neuroengineering.

Computational neuroscience, artificial intelligence, and neuroengineering have, thus, become hot topics attracting scientists from different departments in a new front of strong interdisciplinarity. This reunion of minds and talents must be fostered by, among other initiatives, the opportunity to gather people in vibrant scientific meetings. Thus, the goal behind the biannual Latin American Workshop on Computational Neuroscience (LAWCN) series is to provide scientists – established or in training – with an inspiring opportunity to get together and exchange experiences and ideas that may foster new avenues of interdisciplinary brain investigation and induce the formation of robust collaborative networks of researchers. Particularly, there is a prevalent interest in integrating the academic community of Latin America, whose collaboration networks are not fully developed when compared, for instance, with those involving European nations and the USA. Moreover, the LAWCN workshop aims at congregating neuroscientists coming from different backgrounds, particularly in the areas of computational neuroscience, neuroengineering, artificial intelligence, and neurosciences in general to foster high impact interdisciplinary science.

The second edition of the workshop (LAWCN 2019) was held with great success in the historic city of São João Del-Rei, Minas Gerais, Brazil, during September 18–20, 2019. During these labor-intensive 3 days, participants had the opportunity to listen to the brilliant lectures from 8 world-class scientists from Brazil and abroad (Italy,

Norway, Colombia, and Ecuador), and also to attend the presentation of accepted papers in 15-minute sessions or accepted posters in a 2-hour session. New ideas, collaborations, and friendships were cemented during our coffee-breaks and social events, served with exquisite local cuisine and an inspiring atmosphere in the historic city surrounded by beautiful nature.

All manuscripts submitted were reviewed in a single-blind fashion by at least 3 experienced reviewers from our Program Committee, comprised of members from 18 different countries located on 4 different continents. The papers found in this volume (1068) of Springer's *Communications in Computer and Information Science* (CCIS) were among the top 20 of accepted papers, and thus represent science of excellence performed in different multidisciplinary centers of investigation across Latin America. They encompass all areas of the event. While being highly interdisciplinary, they have been grouped under the areas of artificial intelligence, machine learning, and related topics; complex systems and complex networks; computational neuroscience of learning and memory; neural signal processing; software and hardware implementations in neuroscience; brain-machine interfaces and neurostimulation; and seizure prediction.

LAWCN 2019 was organized by the Laboratory of Neuroengineering and Neuroscience (LINNce – Laboratório Interdisciplinar de Neuroengenharia e Neurociências) of the Federal University of São João Del-Rei (UFSJ – Universidade Federal de São João Del-Rei), ranked second in the Category Normalized Citation Index (CNCI) – a measurement of international research impact – as assessed by the recently published report from Clarivate Analytics, entitled "Research in Brazil: funding excellence," regarding Brazilian science in the period of 2013–2018. The conference was supported by the Electrical Engineering Graduate Program (PPGEL/CEFET-MG – UFSJ), the Provost Office for Research and Graduate Programs (PROPE – Pró-reitoria de Pesquisa e Pós-graduação/UFSJ), the Office for International Affairs (ASSIN – Assessoria Internacional/UFSJ), the Online Education Center of UFSJ (NEAD – Núcleo de Ensino à Distância/UFSJ), and the Academic League of Medical Anatomy (LIAC – Liga de Anatomia Clínica). Financial aid was provided by PROPE, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), and the International Brain Research Organization – Latin American Regional Committee (IBRO-LARC). The event was also sponsored by UNIMED São João Del-Rei, YED, and CONECTA MG. NEUROMODEC was the advertising partner of the conference worldwide. Last but not least, Springer Nature has become a key collaborator of LAWCN as the publisher of our top papers in the very reputable book series CCIS.

To all these organizations, to the keynote speakers, to the authors, and to all the participants, we, the editors of CCIS volume 1068, would like express our most heartfelt gratitude for helping us put together an awesome event and this excellent book. Thank you!

September 2019

Vinícius Rosa Cota
Dante Augusto Couto Barone
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Contents

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