MARIE SKŁODOWSKA-CURIE POSTDOCTORAL FELLOWSHIPS 2023

EXPRESSION OF INTEREST FOR HOSTING MARIE CURIE FELLOWS

HOST INSTITUTION

Nova Information Management School (NOVA IMS)

RESEARCH GROUP AND URL

Data Analytics Lab (https://magic.novaims.unl.pt/en/nova-analytics-labs/nova-data-analytics-lab/)

SUPERVISOR (NAME AND E-MAIL)

Mauro Castelli (mcastelli@novaims.unl.pt)

SHORT CV OF THE SUPERVISOR

Mauro Castelli has a Ph.D. in Computer Science obtained at the Università di Milano Bicocca (Italy), a Master's in computer science, and Degree in Computer Science obtained at the Università di Milano Bicocca (Italy). He is currently an Associate Professor at the Universidade Nova de Lisboa, and a member of the Scientific Council of NOVA Information Management School (NOVA IMS). He is also a researcher at the Information Management Research Center of this university. He participated as a principal investigator, co-principal investigator, or work package leader in different research projects at national and international levels. He collaborated with several European universities on the application of machine learning methods for addressing complex real-world problems.

It has international collaborations with researchers in more than twenty different countries and with universities recognized as leaders in the area of artificial intelligence. He is a member of ACM (Association for Computing Machinery) and SIGEVO (ACM Special Interest Group on Genetic and Evolutionary Computation). He is the author of more than 150 scientific publications and has presented about fifty seminars, conferences, and communications. He was awarded in 2013 and 2014, in the framework of the main European conference of Artificial Intelligence and Evolutionary Computing, for the quality and contribution of his scientific research. He participated in research projects concerning the implementation of machine learning solutions with companies and organizations.

His research focuses on the following areas: Evolutionary Computation, Deep Learning, Machine Learning, Neuroevolution. He was the supervisor of more than 120 master theses and nine Ph.D. theses in the field of Machine Learning.

5 SELECTED PUBLICATIONS

- Philippi, D., Rothaus, K., & Castelli, M. (2023). A vision transformer architecture for the automated segmentation of retinal lesions in spectral domain optical coherence tomography images. *Scientific Reports*, *13*(1), 517.
- Albuquerque, C., Henriques, R., & Castelli, M. (2022). A stacking-based artificial intelligence framework for an effective detection and localization of colon polyps. *Scientific Reports*, *12*(1), 17678.
- Bakurov, I., Buzzelli, M., Schettini, R., Castelli, M., & Vanneschi, L. (2023). Full-Reference Image Quality Expression via Genetic Programming. *IEEE Transactions on Image Processing*, *32*, 1458-1473.
- Bakurov, I., Buzzelli, M., Schettini, R., Castelli, M., & Vanneschi, L. (2022). Structural similarity index (SSIM) revisited: A data-driven approach. *Expert Systems with Applications*, *189*, 116087.
- Kandel, I., & Castelli, M. (2020). The effect of batch size on the generalizability of the convolutional neural networks on a histopathology dataset. *ICT express*, *6*(4), 312-315.

PROJECT TITLE AND SHORT DESCRIPTION

Optimizing neural networks' topology through evolution

Artificial neural networks (ANNs) are nowadays used to address complex problems over different domains and produce state-of-the-art results. Nonetheless, ANNs' performance depends on the choice of the network's topology (i.e., the number of layers and neurons), and no formal rules exist to guide practitioners in this fundamental choice.

This project focuses on neuroevolution, the artificial evolution of neural networks that aims at automatically finding the right topology and connection weights for a given problem. While several neuroevolution methods were proposed in the literature, they all require significant computational resources and an unbearable amount of time before producing a suitable topology.

The project aims to define new methods to efficiently evolve ANNs' topologies and, in particular, the possibility of exploiting evolutionary computation (EC) techniques for this task. The main goal of this project is to translate to the field of ANNs recent advances in the field of EC, thus allowing for an effective search for the best topology for a given problem. The successful completion of this project will have relevant impacts from the theoretical and practical perspectives: (1) it will contribute to a better understanding of the EC search process and the properties of the search space; (2) it will improve the performance of existing ANNs by optimizing their topologies; and (3) it will foster the use of deep learning and neuroevolution also in those environments in which computational resources are scarce.

SCIENTIFIC AREA WHERE THE PROJECT FITS BEST*

Information Science and Engineering (ENG)

***Scientific Area where the project fits best** – Please select/indicate the scientific area according to the panel evaluation areas: Chemistry (CHE) • Social Sciences and Humanities (SOC) • Economic Sciences (ECO) • Information Science and Engineering (ENG) • Environment and Geosciences (ENV) • Life Sciences (LIF) • Mathematics (MAT) • Physics (PHY)