1. Short CV of the advisor

Leonardo Vanneschi

Leonardo Vanneschi is a Full Professor (Professor Catedrático) at the NOVA Information Management School (NOVA IMS), Universidade Nova de Lisboa, Portugal. His main research interests involve Machine Learning, Data Science, Complex Systems, and in particular Evolutionary Computation. His work can be broadly partitioned into theoretical studies on the foundations of Evolutionary Computation, and applicative work. The former covers the study of the principles of functioning of Evolutionary Algorithms, with the final objective of developing strategies able to outperform the traditional techniques. The latter covers several different fields among which computational biology, image processing, personalized medicine, engineering, economics and logistics.

He has published more than 200 contributions, 83 of which in internationally renown scientific journals with impact factor and 10 of which have been honoured with international awards. He has led several research projects in the area, participating in a large number of other projects.

His work has been consistently recognized and appreciated by the international community from 2000 to nowadays. In 2015, he was honoured with the Award for Outstanding Contributions to Evolutionary Computation in Europe, in the context of EvoStar, the leading European Event on Bio-Inspired Computation. In 2020 he was ranked in the top 2% world scientists by a study of the Stanford University.

He has been keynote invited speaker in numerous national and international events. He is a member of the editorial board of three international scientific journals and of the steering committee of several international conferences. He has regularly organized national and international conferences and workshops.

Since 1999, he has consistently been teaching a large number of discipline, broadly covering the entire area of Computer Science, for several different types of students (beginners, experts, computer scientists and coming from other areas). In the last decade, his teaching activity was particularly specialized in the areas of Intelligent Systems, Machine Learning and Data Science. He has received several awards and distinctions for his pedagogical activity.

2. Description of the research group

MagIC

The Information Management Center (MagIC) is the research center of Nova Information Management School (NOVA IMS), which is one of the worldwide leading schools in the area of Information Management. NOVA IMS is also ranked in the TOP 5 of the Best Masters and Postgraduate Programs in the world by the Eduniversal and the first European Institution to obtain the ABET accreditation.

With over 50 integrated researchers and more than 1000 published articles since 2011 (752 articles WOS or Scopus indexed), the primary objective of the MagIC working group is to contribute to the advancement of the fields of Information Management and Data Science. The research center is organised around 4 research streams: Data Science, Information Systems, Geoinformatics, and Data-Driven Marketing.

The working group of Data Science has two main branches. One is dedicated to the study of data generation algorithms for imbalanced learning. The other branch, in which the student will be working, is focoused on supervised learning algorithms through the application of Evolutionary Computation (EC) strategies. This includes the theoretical and practical study of EC, the development of EC models and innovative applications of these models.

In 2020, NOVA IMS and MagIC have launched a Data Analytics Lab, leadered by Professor Leonardo Vanneschi. This lab is a location where students working in Artificial Intelligence and Data Science can share a very friendly environment, with comfortable space and facilities, ideal for social networking and collaborations. The majority of the students and young researchers of the Data Analytics Lab work on Evolutionary Computation.

3. Description of the work to be carried out by the student

Following the biological inspiration of EC techniques, the ecological relationship of cooperation can play an important role on evolutionary algorithms. Cooperative Genetic Programming (GP) can be seen as an example of esemble, in which many solutions are combined to produce the final algorithm prediction. However, a cooperative approach is more than that. For true cooperation to happen, individuals should not only be combined, they should also mutually benefit from the interaction [1].

In [2], the authors proposed the Progressive Insular Cooperative (PIC) GP, a cooperative GP for multiclass classification in which the degree of interaction amongst the solutions can be tunned over the algorithm evolution. This is made by only three simple parameters and this can help the algorithm to balance the exploration and the exploitation of the search space. For binary or multi-class classification problems, the population is divided in subpopulations of individuals specialised in classifying each of the target classes. The final algorithm prediction is given by a higher-level individual, called team, which combines the outcomes of the specialist individuals. As there is no guarantee that good specialists will make a good team, in PIC GP teams can also evolve. Therefore, the algorithm produces good specialists, but, more importantly, it also produces good teams.

Based on PIC GP, the student will work on developing cooperative GP algorithms for regression problems. Some open issues on this project are how to create the subpopulations of specialists and how to combine the outcomes of the specilised individuals to give the final algorithm prediction.

References

1. Boucher, D.: Mutualism. Integr. Comp. Biol. 56(2), 365–367 (2016)
2. Rebuli, K. B., Vanneschi, L. An Empirical Study of Progressive Insular Cooperative GP. SN Computer Science 3 (2), 1-16 (2022)

4. Other relevant information

Lisbon is the capital and the largest city of Portugal. It is recognised as an alpha-level global city because of its importance in finance, commerce, media, entertainment, arts, international trade, education and tourism. It is a very multifaceted and multi skilled city. Morevoer, it is a safe town, which foster the dissemination of culture all around - a perfect environment for students. The climate of Lisbon is great and the city was considered the 23rd World's Best City to Live by Monocle Magazine (July / August 2011).

NOVA IMS is located in an excellent neighborhood of Lisbon, with public transportation and all facilities nearby. The School was founded in 1989 and currently it provides education at the highest level to more than 3.000 students from more than 80 countries. They are undergraduates, post-graduates, masters and PhD degree students. The vocation of NOVA IMS is to contribute in a pioneering and leading way to the conversion of data into value through Data Science, by an integrated and properly articulated commitment to teaching, research, and third mission initiatives. NOVA IMS é driven by what is genuinely central to the best higher education institutions. In the journey of affirmation for the quality of NOVA IMS is formed by the attraction of great students, teachers, and researchers, accompanied by support services provided by great professionals; a human community that through an agile, uncomplicated, vibrant, motivating environment, based on meritocracy and a strong internal cohesion, is encouraged to dream and fulfill dreams in a context of great intellectual and creative freedom.