

## DESCRIPTION OF THE WORK TO BE CARRIED OUT BY THE STUDENT AWARDED WITH THE SPECIES SCHOLARSHIP

The work carried out by the student receiving the SPECIES scholarship should be framed in the context of Vectorial Genetic Programming (VE\_GP), a recent Genetic Programming (GP) variant, presented for the first time by our research team at EuroGP 2019.

Time series prediction is an affordable problem for GP, however some data manipulation is required to build a suitable dataset for the technique. Time series have to be split in different fitness cases, or in different time variables or, in addition, to be collapsed using aggregating functions. All these handlings carry some problems: loss of time order information, loss of time dynamics information and impossibility of treating time series of different length. The work developed on VE\_GP exploits the vector representation to keep together time series and introduce aggregating functions as primitive functions. These novelties are combined with new tools in the classical GP structure to fully and properly benefit from them. The approach of VE\_GP allowed us to obtain promising results on benchmark problems and, more interestingly, on some real-life applications. In particular, concerning the prediction of mosquito dynamics, VE\_GP allowed us to avoid the use of an artificial variable included in the dataset to reflect the knowledge about the shape of the dynamics, that otherwise would have been lost, due to data representation. Our research group is now exploring the use of geometric semantic operators in VE\_GP to understand if they have limitations or they enhance the predictive ability. A first contribution in this direction will be presented at EuroGP 2020.

Following the idea of totally letting the evolution infer knowledge from data, we are currently working on the idea of a co-evolution of two populations. The rationale behind this idea is the following: the function set is made of aggregating functions that group together vector values to return a (hopefully) more meaningful one; these functions include, for instance, mean, median, sum, maximum etc. What if instead of forcing certain aggregating functions we evolve a population of aggregating functions that will be used by the evolving the VE\_GP population? This research is still ongoing and characterized by many open questions, that will be investigated during the scholarship, that will take place in the facilities of the NOVA Information Management School (NOVA IMS) of the Universidade Nova de Lisboa, in Portugal.