

You are cordially invited to the PhD Defense on:

Learning Schemes for Efficiently Training Neural Networks for Protein Secondary Structure Prediction

Mr. Michalis Agathocleous
University of Cyprus, Cyprus

Friday, May 31, 2019
10.00-11.00 EET

Room 148, Building 12
Faculty of Pure and Applied Sciences, New Campus

Abstract

The field of deriving non-linear functions to classify sequential data is currently dealt with by a variety of Machine Learning (ML) methods. The procedure of learning sequential data becomes even more challenging when the upstream and downstream information of a sequence is also useful for the prediction. This is the case with the Protein Secondary Structure Prediction (PSSP) problem, which is a classification problem where the information in the past and future of a specific time frame is important for prediction purposes. In this work we prescribe certain methodologies, architectures and algorithms that have advantages over known methods in terms of accuracy or quality of results or convergence time specifically for the PSSP problem. Our efforts resulted in implementations that contribute towards the above factors with: (1) the implementation of a Bidirectional Recurrent Neural Network (BRNN) which is based on the local information of a protein sequence as a way to reduce the training time, (2) the first comparative study on the challenging problem of filtering methods for the PSSP problem, utilizing both ML techniques and empirical rules, (3) the development and implementation of ML methodologies based on BRNNs where the Scaled Conjugate Gradient and the Hessian Free Optimization (HFO) second-order learning algorithms are applied for the first time on these architectures for fast training, (4) the design and implementation of a novel image-like input representation method for the PSSP problem which is used by Convolutional Neural Networks, (5) the implementation of simple Feed Forward Neural Networks trained with the HFO algorithm to show the limit on what methods may be able to capture when they rely only on local sequence patterns for the PSSP problem and (6) the application of Clockwork Recurrent Neural Networks and a novel Bidirectional Echo State Network to the same problem.

Short Bio:

Michalis Agathocleous is a Ph.D. candidate at the Department of Computer Science under the supervision of Prof. Chris Christodoulou. He holds a BSc degree in Computer Science from the University of Cyprus (UCY) and he pursued postgraduate studies at University College London, University of London, where he awarded with a specialized MSc degree in Machine Learning. He is currently an active member of the Computational Intelligence and Neuroscience group at the UCY and an active member of the Artificial Intelligence Lab at the University of Nicosia (UNIC). He worked at the Department of Computer Science at UCY as a Research Assistant for a Research Promotion Foundation project on developing second order ML algorithms for the PSSP problem. During his studies he was awarded Ph.D. Scholarships from the Graduate School of the University of Cyprus, the A.G Leventis Foundation and the Cyprus State Scholarship Foundation. He assisted in teaching classes such as Computational Learning Systems, Machine Learning and Data Mining, Theory of Computation and Complexity and Introduction to Programming and Problem Solving. He is currently working as Senior Software Engineer and Data Scientist in Goldman Solution and Services. During this past academic year, he also worked as a part-time lecturer for a Neural Networks course at the UNIC. He is also a Co-director at his own company (Resoloupe LTD) which specializes on Machine Learning and Data Science related projects and services. He has attended several international conferences for presenting his published research work and he has published works related to bioinformatics, recurrent neural networks, deep learning and general Machine Learning algorithms. His main research interests are Neural Networks, Deep Learning, Evolutionary Computation, Machine Learning and Bioinformatics.

Host: Prof. Chris Christodoulou (cchrist-AT-cs.ucy.ac.cy)