Knowledge Lab
Birkbeck UNIVERSITY OF LONDON

Research Student
Cosmin Stamate

Supervisors
George Magoulas
Michael Thomas

developmental neurocognition lab

CBCD Centre for Brain and Cognitive Development

Birkbeck UNIVERSITY OF LONDON
Department of Computer Science and Information Systems

Behavioural Genetics-inspired high-order connectionist modelling

Research Aims

Our overall aim is to develop new, more realistic computational models that can be used to simulate cognitive and behavioural modelling tasks, and can be exploited in a machine learning/artificial intelligence context. These simulations will aid our exploration of the field of cognitive genetics- a term introduced to bridge genetics and cognitive processes. This relatively novel branch of genetics studies the influence of genetic variation on cognition and central nervous system disorders with the help of population and twin studies.

Research Methodology

Model design has as a starting point the work from previous collaboration, the behavioral genetics inspired multi resolution framework (Maitrei Kohli, George D. Magoulas and Michael S. C. Thomas, 2013) in the context of the MSc Thesis: Learning a Diverse set of Tasks Using a Behavioral Genetics Inspired Approach. We have chosen to elaborate on this work as it has produced good results that can be further improved by incorporating state-of-the-art computational models which will allow us to deepen the extent of our experiments. First we will replace the previous computational abstraction (feed forward neural networks) with state-of-the-art deep neural networks (Yu, Dong and Deng, Li, 2015). This will enable us to encode a whole new spectrum of intrinsic parameters in the genome thus extending and enriching the neuro-computational framework. Next we will improve the genotype-to-phenotype representation of the genetic algorithm (GA). This requires changes in order to accommodate for the deep neural networks larger number of intrinsic parameters and also to provide a more realistic representation of this abstraction. Deep learning encompasses a vast number of architectures which we will implement to achieve the desired cognitive models.

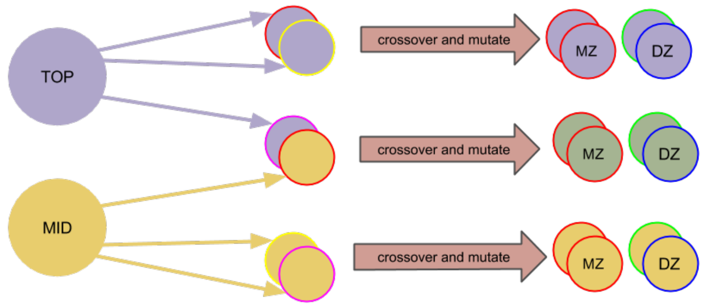

Figure 1. Hybrid artificial breeding transfer of learning.

Research Approach

To date we have developed a novel algorithm, which can be seen in Figure 1, that exploits the synergies between a population-based framework and artificial breeding techniques. The result is an optimized transfer of learning algorithm that performs well on quasi-heterogeneous tasks. We have also developed a novel random weight initialization algorithm for deep neural networks that takes inspiration from Linear Interval Tolerance-LIT. We would like to extend the transfer of learning framework to include the weight initialization advances obtained with Deep LIT. This framework will also include all the networks developed for signal to images learning.

Publications

C. Stamate, G. Magoulas, M. Thomas: Transfer learning approach for financial applications. Proceedings of UK conference on Computational Intelligence (UKCI 2015).

C. Stamate, G. Magoulas, M. Thomas: Initialising Deep Neural Networks: an Approach based on Linear Interval Tolerance. Proceedings of IEEE SAI Intelligent Systems Conference (IntelliSys 2016).