Mixed Order Hyper Networks in Optimisation

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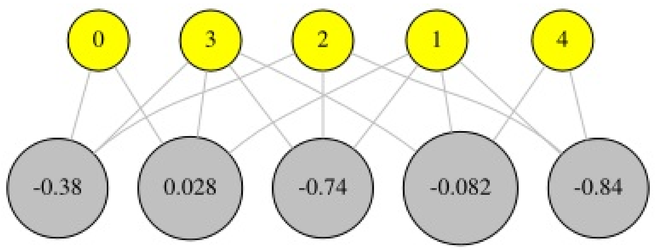
Context

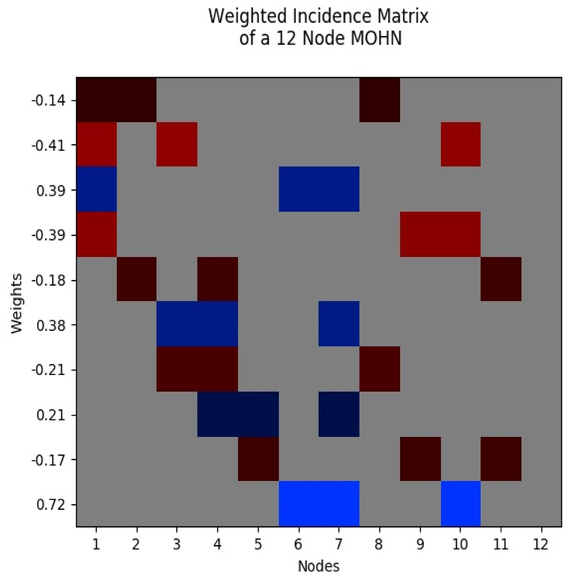
Many difficult optimisation problems can be tackled using Genetic Algorithms, but this can involve many generations with vast numbers of new candidate solutions, for each of which the objective function must be evaluated.

This can often be improved on using Estimated Distribution Algorithms (EDAs) which reduce the number of generations by attempting to predict the population distribution that a Geneteic Algorithm would lead to.

Mixed Order Hyper Networks (MOHNs) are a machine learning technique that can be represented by networks with "edges" that connect any number of nodes rather than just two.

They provide an alternative for binary encoded problems by modelling the objective function in a way that can be analysed to simplify identifying the the optimum.





The Problem

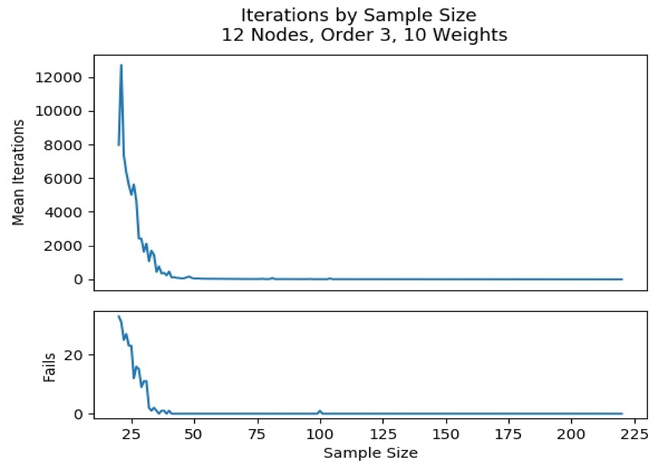
As a machine learning technique, discovery of the model structure is itself an optimisation problem. To discover the perfect solution in one step is possible, but is equivalent to an exhaustive search.

While better methods exist for discovering the structure, the question of how to minimise the number of samples, and therefore evaluations of the objective function, in the process remains.

The Approach

The project restricts itself mainly to problems that are known to able to be be modelled by a sparse MOHN with edges of a single order. This simplifies the process with the intention of increasing transparency.

A range of algorithms for structure discovery are developed using both greedy heuristics and stochastic elements. The relationship between their performance and sample size is investigated.



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