Stochastic Diffusion Search for

edge weighted graphs

by

Marcellino Samuels

# Aims and Objectives

This project aims to solve the following problem using an implementation of Stochastic Diffusion Search (SDS) algorithm. Given an edge weighted graph where each node has been given a value, find the optimal minimum tree which visits X nodes and maximises the value of the tree, where X is a number of nodes in the tree. The project implementation of SDS will be in java using the eclipse IDE which is free and readily available online.

# Applications

As this project aims to find a minimum tree of a graph it can be applied to any problem that can be represented as a graph and solved by finding the minimum spanning tree. This means that there are many applications for this in the field of computer science (Riaz, F. and Ali, K. 2011). However, this range of problems also fall within the scope of graph theory. Graph theory is a field of mathematics which uses edges and nodes to represent relationships between objects. The origins of graph theory can be traced back to the Seven Bridges of Konigsberg problem 1735 (Newman, 2000). The was solved by Leonhard Euler a well-known mathematician of his time. The method he created to overcome this problem became the foundation of graph theory (Wilson, James & Lloyd, 1976).

An example of an application would be the following:

Each node represents a location and the value of each node represents its importance in the trade network. The weights of each edge represent the distance between each location. The algorithm will try to find the highest value network which minimises the distance travel.

# Evaluation

The first stage of the evaluation will be aimed at proving that the solutions the SDS implementation return are optimal. In order to achieve this goal, both SDS and Dijkstra’s algorithm will be tested over a set of graphs and the results to compare the results. The accuracy for SDS will be found and can be considered successful if over 90%. Dijkstra’s has been selected as given an edge weighted graph it returns an optimal minimum spanning tree. If this succeeds then the next step is to run the same test but for trees of that are X in size.

The final stage will look at finding the average convergence rate over a set of benchmarking graphs. For each graph a suitable set of parameters will be found by using a method similar to nested cross validation. This method will use an elitist approach to test a variety of parameters per graph, the best parameters will be used for the specific graph they were found on.

# Bibliography

Newman, J. (2000). *The world of mathematics.* Mineola, N.Y.: Dover Publications.

Riaz, F. and Ali, K. (2011). Applications of Graph Theory in Computer Science. *2011 Third International Conference on Computational Intelligence, Communication Systems and Networks.*

Wilson, R., James, W. and Lloyd, K. (1976). *Graph theory, 1736-1936.*