# Abstract

# Introduction

# Applications/Graph Theory

# Algorithms

# Implementation

The java implementation has been constructed using object-oriented programming (OOP). The variables for each class are private with setter and getters to incorporate encapsulation.

The first stage of the implementation was to create an edge weighted graph as a framework for the program. An edge weighted graph consists of two main components which are represented in the java implementation by an Edge class and a Vertex class. These classes create the foundation for the Edge Weighted Graph class that can theoretically convey any graph. In order to traverse the edge weighted graph both classes need to retain information which pertains to the other class.

A vertex or node is a point within the graph that is often labelled. These can be connected to each using edges. These ideas translate into the following variable:

* String label – Allow for the vertex to be labelled
* HashSet<Edge> edges - A set of all edges that are attached to this vertex

Each new Vertex class is instantiated with a String variable as an argument. The constructor uses the String as the label for the class then creates a new HashSet<Edge>. A string has been used for the label to allow any character to denote the vertex. The HashSet<Edge> has been implemented as it is a dynamic data structure that will prevent duplicate connections between vertex classes. An addition benefit of this data structure it that the search time for an Edge will be constant. This will help reduce the time taken for each traversal which is important as the method that will be used to check for loops when generating a new hypothesis and within Kruskal’s algorithm is the depth first traversal.

An edge is used to connect to vertices within a graph. For an edge weighted graph the edge will have a weight linked to itself. These concepts translate into the following variables:

* Vertex Vertex1 – A vertex class which the edge is connected to
* Vertex Vertex2 – The other vertex class which the edge is connected to
* double Weight – A double that represents the weight attached to the edge

No data structure have been used to store the two Vertex classes as the maximum number of vertex

This information is passed to the class each time a new Edge class is instantiated.

The class constructor has been overloaded to allow for two constructors. This allows for the representation of regular graphs and for weighted graphs. As such the first constructor takes two Vertex classes and sets the weight to 0 to express a regular graph. The second constructor takes two Vertex classes and a numerical value (double) for the weight to express the weighted graph.

A private method named initialize() has been created which takes two vertex classes as an argument. The method calls the add() method of each vertex class given to add the newly created edge (this) to the edge sets of each vertex class. This method has been created private to enforce encapsulation as the initialize() method is only required within the edge class.

The Edge class has been given a special getter method to help with the traversal of the graph. The method is called getOther() and takes a vertex as an argument. The method will then check if the vertex is connected to the node. If the vertex is connected to the node, then method will return the vertex that is connected to the over side of the edge. If the vertex is not connected to the node then with method returns null.

For the following example the vertex class variables will be named V1 and V2 respectively:

## (Code)

# Testing and Errors

Test Driven Development (TDD)

# Methodology

Waterfall

# Research

# Results

# Future Development

# Conclusion