



NETWORK SOFTWARE MODELLING

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**Assignment One - Dijkstra algorithm**

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## 1 Dijkstra's Algorithm

Briefly describe Dijkstra's algorithm for solving the shortest path problem (which we have covered in class), including a statement of its time complexity.

The answer

Dijkstra's Algorithm is among the most fundamental algorithms in modern computer science, used for finding the path of lowest cost between a given point in the graph, and all others. More formally; Given a vertex  $s$  in a weighted directed graph  $G = (V, E)$  where edges are non-negative, Dijkstra's Algorithm finds the path of lowest cost from  $s$  to all other vertices in  $G$ . This is sometimes referred to as the *single-source shortest path problem*.

The algorithm does this as follows; all nodes are assigned some cost value, set to zero for the initial node and infinity for the rest. All vertices, except the initial one, are passed into a set which is cycled through. The neighbors of the initial node are considered first, taking the cost (or distance) associated with that journey between the nodes.

## 2 Bidirectional Dijkstra's Algorithm

**Describe the bidirectional Dijkstra algorithm and a variant which is more efficient in practice** *In order to understand it, you can research it in textbooks, MOOCs, blogs, or other external resources. State any assumptions needed for the algorithm to work.*

The answer

## 3 Dijkstra's Original Algorithm - Comparison

With the aid of a diagram, explain how it differs from Dijkstra's original algorithm.

The answer

## 4 Time Complexity

State its time complexity and explain why it is more efficient.

The answer

## 5 Implementation

Implement both Dijkstra's algorithm and the bidirectional variant, using appropriate data structures for efficiency.

The answer

## 6 Run-Time behavior

**Test the run-time behavior of both algorithms on randomly generated graphs of varying sizes in order to demonstrate their scaling behavior. Include a table of data showing run-times.**

The answer

## 7 Conclusions

**Briefly state your conclusion concerning run-time behavior.**

The answer

## References