Technische Universiteit **Eindhoven** University of Technology

Minimum spanning trees in temporal graphs

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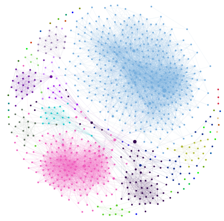

Scope

Huang et al. claimed they could improve upon running time of current DST approximation algorithms dramatically while keeping the same approximation degree. The theoretical running times of their algorithm compared to the original algorithm is as follows:

$$R_{old} = O(n^i k^{2*i}) \quad (1) \qquad R_{new} = O(n^i k^i) \quad (2)$$

With n being the number of vertices, k the number of terminals in the graph and i the amount of iterations of the algorithm.

To verify the claims made by Huang et al. we have implemented and analyzed both the original algorithm as well as the algorithm proposed by Haung et al. These approximation algorithms for calculating minimum spanning trees in temporal graphs, both algorithms compute their result through transformation of the problem to a directed steiner tree (DST).

Approach

Both algorithms require several pre-processing steps: A transformation to DST and a transitive closure computation.

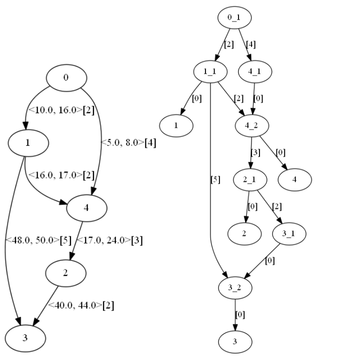

Figure 1: MST before transformation to a DST (left) and the resulting DST (right)

Both algorithms being an approximation algorithm, can improve it's results by increasing the amount of iterations (recursions) it does. The results of the algorithm have to undergo some post-processing to finally achieve the MST's:

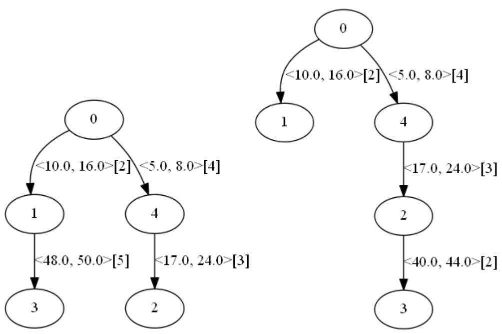

Figure 2: Resulting MST's with iteration depth 1 (left) and 2 (right) resulting in weights 14 and 11

Analysis

We compared the running time of the two algorithm through an experimental approach by making use of several data sets with differing sizes and features. The results of the analysis are depicted below where the algorithms have been plotted by comparing the number vertices as well as the degree of the vertices to the experimental running times.

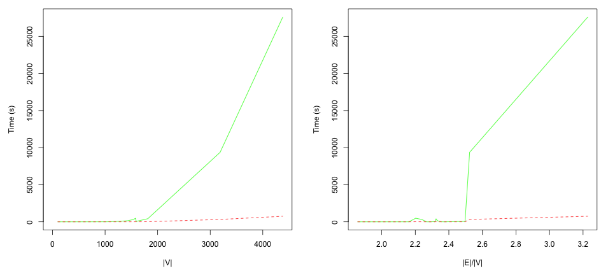

Figure 3: Running time comparison of old algorithm (green) with new algorithm (red) compared to the number of vertices and degree of the graphs

Additionally, we compared the results against their theoretical running times using a difference plot.

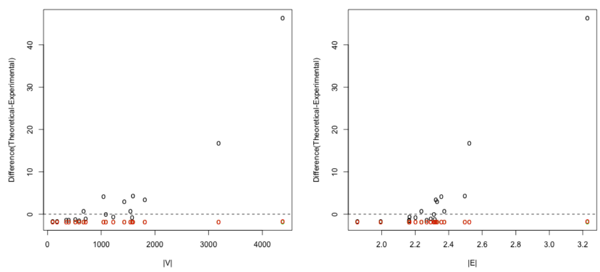

Figure 4: Difference plot comparing theoretical and experimental running time of both algorithms: old algorithm (green), new algorithm (red), both (black).

The results we received were very promising and seem to confirm the claims made by Huang et al.

Test data distribution

The data we used for our tests was distributed as follows:

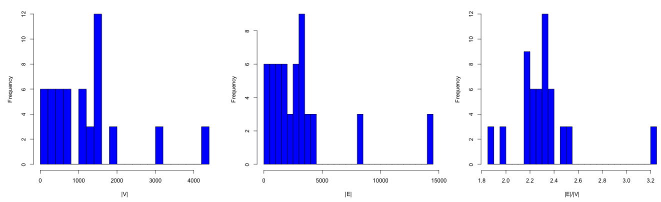

Figure 5: Data distribution