

Posudek diplomové práce

Matematicko-fyzikální fakulta Univerzity Karlovy

Thesis author Sasha Sami

Thesis title Parameterized Algorithms for 2-Edge Connected Steiner Subgraphs

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Program Computer Science **Specialization** Theoretical Computer Science

Review author Dr. Andreas Emil Feldmann **Role** advisor

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Review text:

The thesis considers several related problems in network design, where the input consists of a graph G and a set of terminal vertices, and the task is to compute a minimum cost subgraph H of G connecting all terminals. For undirected input graphs, the computed solution H should be 2-edge connected, and the two considered variants of 2-ECSS and 2-ECSM arise from allowing only one copy of each edge or several copies, respectively. For directed input graphs the Bi-SCSS problem is considered, where the terminals need to be strongly connected in H .

These problems are studied from the point of view of parameterized algorithms, where the used parameter is the number of terminals. For unweighted 2-ECSS the thesis presents a randomized XP algorithm, which was previously not known to exist. The main idea here is to guess the vertices at which the ears of an ear decomposition of the solution attach. It is shown that the number of such vertices is linearly bounded in the input parameter. Guessing these vertices leads to an XP running time. The ears can then be computed via a known algorithm by Björklund et al. Unfortunately, the same XP algorithm (with slight differences but the same overall strategy) for 2-ECSS was obtained and published by Bansal et al. shortly after the student found it. Given that the student found the algorithm independently still proves the student's capabilities of producing original ideas and research, and I can attest that he obtained this result without much of my intervention.

For weighted 2-ECSM the thesis presents an FPT algorithm based on prior work by Feldmann et al. on the related SNDP problem. Then a reduction from weighted Bi-SCSS to 2-ECSM is given, which implies a faster FPT algorithm for Bi-SCSS than was previously known. While these results are not as sophisticated from a technical point of view as the above XP algorithm for 2-ECSS, they still improve on a known algorithm by Feldmann et al. for Bi-SCSS. This again proves the strength of the student's research abilities.

The writing style of the thesis is generally good: it is rather clear and the proofs seem correct.

However, some of the arguments (especially in section 2) could be made more concise, and some more high level ideas would have helped to clarify some of the arguments on a more intuitive level. The thesis also suffers from some minor inconsistencies in notation. All in all, I am quite satisfied with the thesis though, and I highly recommend it for acceptance.

I recommend the thesis for defense.

I suggest to not consider the thesis for the annual award.

date 23.1.2023

Signature:

