SHORT TERM SCIENTIFIC MISSION (STSM)
SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: CA 16228
STSM title: Parameterized Complexity of Stable and Popular Matchings
STSM start and end date: 03/06/2019 to 07/06/2019
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PURPOSE OF THE STSM:

(max.200 words)

The well-known stable matching problem asks, given a set of agents, each with preferences over a subset of the other agents, to assign the agents to each other in such a way that no pair of agents profits from disobeying the matching, meaning that there is no pair of agents who prefer each other over their assigned partner. While the most basic stable matching problem, Stable Marriage, is solvable in linear time, several generlizations become NP-hard.

In the STSM, we wanted to study the computational complexity of such problems. Thus, we aimed to either design efficient algorithms or prove hardness results such as NP-hardness or W[1]-hardness for these problems.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

(max.500 words)

We started by discussing recent literature on stable matchings and open problems. We observed that it is well-known that the problem of finding a maximum weakly stable matching is NP-hard even if each agent is only acceptable to few (at most three) other agents, while it is easy to find a maximum matching if each man accepts each woman and vice versa; however, it was not known whether it is still hard to find a maximum weakly stable matching where almost all man-woman pairs are acceptable. Thus, we investigated the computational complexity of Stable Marriage with Ties where the underlying acceptability graph can be transformed to a complete bipartite graph by adding just a single edge.

We also investigate the complexity of a relaxation of stable matchings, called socially stable matchings, in which some edges are allowed to be blocking. The motivation behind this variant is that in practise, not every man pair knows the preferences of all woman and vice versa, and if a man-woman pair does not know that it is blocking, then this should not lead to an instability of the solution.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

We showed that several cases of stable matching problems are NP-complete:

1. Given a Stable Matching instance with Ties and Incomplete Preference Lists, where all but one man-woman pairs are aceptable, decide whether there exists a perfect stable matching. It is also NP-complete whether there exists a non-perfect stable matching.

2. We showed that finding a stable matching not containing a single forbidden edge is NP-complete.

3. Given a Socially Stable Matching with Ties instance, it is NP-complete to decide whether a strongly stable or super-stable matching exists. This even holds if all preference lists are of length at most four and obtained from two master preference lists.

FUTURE COLLABORATIONS (if applicable)

We plan to publish the obtained results.
Furthermore, we plan to continue collaborating on stable and popular matching problems.