COST Action IC1205 on Computational Social Choice: STSM Report

Applicant: Tamás Fleiner
Home institution: SzIT, Budapest University of Technology and Economics
Home country: Hungary
Host: David Manlove
Host institution: School of Computing Science, University of Glasgow.
Host country: Scotland, UK
Dates: 19/08/2014 to 26/08/2014

This STSM was carried out together with Katarina Cechlárová and David Manlove who hosted the visit. Its purpose was to continue our previously started work on studying teachers' assignment problems motivated by a practical problem in Slovakia on student placement. With Katarina Cechlárová, David Manlove, Iain McBride and Eva Potpinková, we already have a joint paper (in Central European Journal of Operations Research) on this topic and our goal during the visit was to bring our model closer to reality by allowing preferences on both sides of the market and to find results in the extended models. In the Teachers' Assignment (TAP) problem, we have a two-sided market: on one side there are applicants each with two specific subjects and the other side has different schools that offer some subjects up to some quota. An assignment is an allocation of a subset of the applicants to schools such that no school receives more applicants with a certain subject than the quota of the school for the particular subject. Each applicant has a linear preference order on a subset of schools that offers her subjects and schools might or might not have preferences over applicants.

We have found the following results during the visit:
1. It is hopeless to construct an efficient algorithm that finds a stable assignment (if such an assignment exists) because already deciding the existence of a stable assignment is NP-complete.
2. There is an efficient algorithm that finds a stable assignment whenever preferences are determined by school-specific or by applicant-specific master lists.
3. However, if subject-specific master lists determine schools' preferences then it is NP-complete to decide whether a stable assignment exists or not.
4. If schools have no preferences over the applicants then our goal is to find a Pareto optimal assignment (instead of a stable one). It is clear, that the maximum size of a Pareto optimal assignment is the same as the maximum size of a feasible assignment. We proved that finding a maximum size assignment is NP-complete, hence there is no hope to find a maximum size Pareto optimal assignment. We know from earlier work that one can find an assignment (which is not necessarily Pareto optimal) of size at least $2/k$ times the size of a maximum size assignment where k is the number of different subjects that schools offer. Moreover, we have an efficient algorithm that constructs a Pareto optimal assignment with size at least one third of any Pareto optimal assignment. We plan further work to find better approximations of the maximum size Pareto optimal assignment.

I also collaborated with Ágnes Cseh on generalized stable matching problems. We could apply a choice function framework based on fixed point to a particular superstable matching problem. Our further goal is a generalization of Blair's theorem to the case where the choice function on one side of the two-sided market is not path-independent.