STSM Scientific Report - COST Action IC1205

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1 Background

Traditionally, trainee teachers in Slovakia (and in the former Czechoslovakia) specialize in two subjects during the course of their training, e.g. Mathematics and Physics, Chemistry and Biology, Slovak language and English etc. In addition to the study of the theoretical aspects of these subjects, each course contains a practical placement in a school several times during the course. During each placement students visit classes and take part in teaching under the supervision of an experienced and suitably qualified teacher. Students might try to find suitable schools with supervising teachers by themselves for their placements, but to ensure the quality of such a placement, each faculty usually maintains a list of such schools and teachers and the students are assigned to them by the faculty staff. Constructing this assignment is not straightforward and can take several days and many trials to assign each student.

The assignment undertaken at P.J. Šafárik University in Košice involves attempting to assign between 100 and 150 trainee teachers during each allocation. These trainees may be studying any two of 14 possible subjects. Currently there are 175 schools with approved supervising teachers. It has been shown [1] that the problem of deciding whether every trainee teacher can be assigned a place is NP-complete even under very severe restrictions on the number of subjects and on the number of supervising teachers available for each subject at each school. The purpose of this visit was to attempt to implement a model of this assignment problem using integer programming techniques developed in [2] since it was recognised that the problem considered in [2], namely the Hospitals / Residents problem with Couples (HRC), was similar to the Teacher Assignment problem in Slovakia. Such a model might be used to find an assignment in which the maximum possible number of trainee teachers are assigned during each allocation, a maximum assignment.

2 The Visit and Future Work

During the visit we were able to succesfully implement an integer programming model for and apply it to the assignment problem at P.J. Šafárik University in Košice. Using this implementation we were able to find a maximum assignment in less than a second in all cases for allocation datasets from the previous 3 years at the University. I was able to work directly with Prof. Cechlarova and her colleague Dr. Tamás Fleiner from Budapest on the theoretical aspects of the Teachers' Assignment Problem

(TAP), the classical combinatorial problem which models this practical assignment problem. We are currently co-authoring a paper presenting complexity results, algorithms and an integer programming model for TAP. The implementation has been used within the past few days to solve the latest allocation at P.J. Šafárik University. Also, as a byproduct of this visit I was able to visit Dr Peter Biró in Budapest to discuss work on other matching problems - this work has also led to some new theoretical results which we intend to publish shortly.

A number of interesting research questions have arisen from this work. A very natural extension to this problem would be to allow trainee teachers to express preferences over the schools available to them. Do similar complexity results to those obtained for the problem in the absence of preferences follow to this new context? Can a more elaborate integer programming model be constructed to ensure that desirable assignments are still produced if trainee teacher preferences are allowed? Also, the similarity of the teachers' assignment problem described here and the Hospitals / Residents problem with Couples (HRC) described in [2] suggests some interesting complexity results and possibly efficient algorithms for some restricted problem variants in the HRC context.

References

[1] K. Cechlárová, TG. Fleiner and E. Potpinková, *Practical placement of trainee teachers to schools*, SOR 2013.

[2] I. McBride and D.F. Manlove, *The Hospitals / Residents Problem with Couples: Complexity and Integer Programming Models*, Technical Report, Computing Research Repository, Cornell University, 2013.