Student-Project Allocation Problem: Three Sided Matching System

CS 254 Data Structures and Algorithms Lab Project

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1 Abstract

We study the Student-Project Allocation problem (SPA), a generalisation of the classical Hospitals/Residents problem (HR). An instance of SPA involves a set of students, projects and lecturers. Each project is offered by a unique lecturer, and both projects and lecturers have capacity constraints. Students have preferences over projects, whilst lecturers have preferences over students. We present two optimal linear-time algorithms for allocating students to projects, subject to the preference and capacity constraints. In particular, each algorithm finds a stable matching of students to projects. Here, the concept of stability generalises the stability definition in the HR context. The stable matching produced by the first algorithm is simultaneously best-possible for all students, whilst the one produced by the second algorithm is simultaneously best-possible for all lecturers. The SPA problem

model that we consider is very general and has applications to a range of different contexts besides student-project allocation.

2 Introduction

In our day-to-day life we usually come across situations which require two sided stable matching, a typical case of which was given by David Gale and Lloyd Shapley as Stable marriage problem. The algorithm they found out took linear time, and the time is linear in the size of the input to the algorithm. We consider an extension to this problem in which we try to find stable matching for three sides.

In case of three sided matching problems, we have to put some constraints over our parameters to get stable matching as shown by Ahmet Alkan. He constructed a three-sided example with n=3 individuals in each group (and appropriate preferences for each individual over all pairs of possible partners) for which no stable matching exists. Stable matching surely exists for cyclic preferences case for n less than 2, but for n greater than 3, it may or may not. Here, we consider a case of acyclic preferences for which the stable matching is found to exist, provided some constraints are added.

3 Algorithms

We try to implement two algorithms for finding a stable matching, given an instance of Student-Project Allocation Problem (SPA).

- The first algorithm is student-oriented, in that it finds the stable matching in which each student obtains the best project that he/she could obtain in any stable matching.

- The second algorithm is lecture-oriented, in that it constructs the stable matching in which each lecturer has as good a set of students (in a precise sense, to be defined) as in any other stable matching.

The algorithms took linear time and we tried to implement them as optimally as possible and in order to do so, we have added some constraints too. They are greedy in nature and their pseudo codes are available in the paper published in the March 2007 issue of 'Journal of Discrete Algorithms' whose reference is given below.

4 References

- D.J. Abraham, R.W. Irving,D.F. Manlove
  The Student-Project Allocation problem Proceedings of ISAAC 2003: the 14th Annual International Symposium on Algorithms and Computation, Lecture Notes in Computer Science, vol. 2906, Springer-Verlag (2003), pp. 474-484