ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Institute of
Theoretical Computer Science

Masterarbeit[1], Semesterarbeit[2]

Set Cover with pairwise profits for crew scheduling of Netherlands Railways

Railway crew scheduling problems are among the most challenging optimization problems that arise in practice. The core of this problem is to feasibly assign railway crews that are based in some home city to work activities, such that all planned train connections of the schedule are covered and the total cost is minimized. The assignment for a single crew is called a *pairing*. For real world instances it currently seems hopeless to solve the sketched optimization task exactly. Instead, almost all approaches resort to some heuristic treatment. One such heuristic is the following:

(1) Generate a (huge) set of candidate pairings by column generation techniques (not part of this project). (2) Solve the resulting set covering problem.

The focus of this project is to incorporate important secondary goals into step (2) of the above heuristic. In particular, the robustness of the selected pairings can be expressed via *profits* that arise from selecting pairs of sets. For this reason the first goal of this line of work is to

(A) Design and analyze possible approximation algorithms for Set Cover With Pairwise Profits (SCPP) There is a close connection of SCPP to dense k-subgraph problems (Feige et. al. 2001), which should be exploited. As a next step it is interesting to

(B) Evaluate the performance of heuristics and/or the Approximation Algorithm of (A) for a real world instance of Netherlands railways. Part (B) of this project is planned as a cooperation with Netherlands Railways.

Requirements: (A) Interest in algorithm design and analysis. (B) Familiarity with Java and/or C++.

For more information please contact: Dr. Marc Nunkesser, CAB H 37.2 , mnunkess@inf.ethz.ch

Literature: U. Feige, G. Kortsarz, D. Peleg, The dense k-subgraph problem, Algorithmica, 410–421, 2001; S. Chebalov, D. Klabjan Robust Airline Crew Scheduling: Move-up Crews, Proceedings of the 2002 NSF Design, Service and Manufacturing Grantees and Research Conference; V. Vazirani, Approximation Algorithms, Springer 2001.

Prof. Peter Widmayer
Institute of Theoretical Computer Science
ETH Zürich, CAB H 15
Universitätstrasse 6
CH-8092 Zürich, www.ti.inf.ethz.ch/pw

[1](A) and (B)
[2](A) or (B)