Second Homework Assignment for Math 408 and 827

Due: Friday, February 16th, 2007, in class.

Problems for Math 408 and 827:

1.-3. Chapter 2 problems 2, 3, 4.

4. Give a example of a $\{-1, 0, 1\}$ matrix A and an integer vector b such that the set $\{Ax \leq b \mid x \in \mathbb{R}^n\}$ is an integer polytope, but A is not totally unimodular.

5. Chapter 3 problem 4.

6. Chapter 6 problem 3.

Additional problems for Math 827:

7. Chapter 3 problem 6.

8. Chapter 4 problem 4.

9. Chapter 6 problem 5.

Reading:

Chapters 4, 6 and 7.

Presentations:

Math 827 students will give presentations of recent research papers in class, which will meet jointly with the Operations Research Seminar. These presentations will take place on March 9th, 16th, 23rd and 30th. Please sign-up for a date, first-come, first-served.

Please also choose a paper. I would like to finalize the choices by Friday, February 9th. The ideal situation would be to choose papers that are relevant to your own research. If you have, or are considering, and advisor, I recommend consulting with them.

A sample of interesting papers is below. These papers are all quite theoretical, more applied papers may also be suitable. I mention them in my estimated order of reading difficulty, from easiest to hardest.

Bárány and Onn [BO97] survey colourful linear programming, a problems that nicely blends combinatorics and geometry. Anstreicher et al. [ABGL02] use all available techniques to solve instances of the QAP, a particularly difficult NP-complete problem. Sturmfels et al. [SWZ95] employ algebraic techniques to attack combinatorial problems. Goemans and Williamson [GW95] use semidefinite programming to produce a very nice approximation algorithm. Barvinok and Woods [BW03] show how to get compact algebraic descriptions of interesting integer feasible sets. Lovász and Schrijver develop a semi-definite relaxation scheme for solving combinatorial optimization problems. Fredman and Khachiyan [FK96] give a very curious algorithm for generating certain types of boolean (true-false) functions. And finally Yannakakis [Yan91] proves that you can't represent the Travelling Salesman Polytope by small, highly symmetric linear programs.

References

[ABGL02] K. Anstreicher, N. Brixius, J.-P. Goux, and J. Linderoth, *Solving large quadratic assignment problems on computational grids*, Math. Program. **91** (2002), no. 3, Ser. B, 563–588.

[BO97] I. Bárány and S. Onn, *Colourful linear programming and its relatives*, Math. Oper. Res. **22** (1997), no. 3, 550–567.

[BW03] Alexander Barvinok and Kevin Woods, *Short rational generating functions for lattice point problems*, J. Amer. Math. Soc. **16** (2003), no. 4, 957–979 (electronic).

[FK96] Michael L. Fredman and Leonid Khachiyan, *On the complexity of dualization of monotone disjunctive normal forms*, J. Algorithms **21** (1996), no. 3, 618–628.

[GW95] Michel X. Goemans and David P. Williamson, *Improved approximation algorithms for maximum cut and satisfiability problems using semidefinite programming*, J. Assoc. Comput. Mach. **42** (1995), no. 6, 1115–1145.

[SWZ95] Bernd Sturmfels, Robert Weismantel, and Günter M. Ziegler, *Gröbner bases of lattices, corner polyhedra, and integer programming*, Beiträge Algebra Geom. **36** (1995), no. 2, 281–298.

[Yan91] Mihalis Yannakakis, *Expressing combinatorial optimization problems by linear programs*, J. Comput. System Sci. **43** (1991), no. 3, 441–466.