

Due: Friday, October 3rd (in class)

Reading

Chapters 3, 6, 7 and 8.

You can skip Sections 3.4 to 3.6 and just get the general idea for Chapter 6. Chapter 8 introduces the main theme for this course – please read the first 6 sections carefully and understand them. Section 8.7 can be browsed, and 8.8 can be skipped.

Problems for Math 408 and Math 708

1. Consider the personal knapsack you made in the first homework assignment.
 - a. Construct a primal (lower) bound for the optimum using the greedy heuristic described in Example 2.4.
 - b. Construct a dual (upper) bound for the optimum by solving the LP relaxation of the problem.
 - c. Compare the two bounds to the optimum you found in the first homework assignment, by writing a simple inequality of the form $l \leq opt \leq u$.
2. Chapter 2 problem 2. Some printings of the text contain a typo: in this question you need to cover the *nodes* with cliques, not the edges as stated the first few printings.
3. Give an 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.
4. Chapter 3 problem 1.
5. Chapter 3 problem 2.

Additional Problems for Math 708

6. Chapter 2 problem 4.
7. A binary (zero-one) matrix has the *consecutive ones property* if its columns can be rearranged so that the ones in each of its rows are consecutive. Show that any matrix with the consecutive ones property is totally unimodular.

Remark: This is the transpose of question 3.3 in the text, however note that you can do it without using the generalized necessary condition.
8. Chapter 3 problem 4.

Graduate student projects

Math 708 students will give presentations surveying recent research topics in integer programming. These presentations will take place in class, on Friday, November 28th, or Monday, December 1st. Presentations will last for 20 minutes, followed by 5 minutes for questions.

The book [1] finishes with a series of surveys of current topics (Chapters 14 through 19), these are well suited to this purpose. Other topics may be possible, please see the instructor if you have something else in mind. It may be helpful to discuss with your advisor which topics are relevant to your research. Please sign-up for a date and topic. First-come, first-served.

References

- [1] Michael Jünger, Thomas Liebling, Denis Naddef, George Nemhauser, William Pulleyblank, Gerhard Reinelt, Giovanni Rinaldi, and Laurence Wolsey, editors. *50 years of integer programming 1958–2008*. Springer-Verlag, Berlin, 2010. From the early years to the state-of-the-art, Papers from the 12th Combinatorial Optimization Workshop (AUSSOIS 2008) held in Aussois, January 7–11, 2008.