Due: Monday, November 28th (in class)

Reminders

Please fill out the on-line course evaluation when available.

The final exam will take place Wednesday, December 14th at noon in SUR 3240.

Reading

Textbook Sections 11.5 and 11.6.

Column generation and the 1-tree relaxation of the TSP, which are covered sparsely in the textbook, appear in Applegate, Bixby, Chvátal and Cook, in Sections 11.4.5 and 4.1, respectively. Chapter 12 gives some additional ideas about how to work with very large scale instances, using different relaxations than in class.

Problems for Math 408 and Math 708

1. Repeat the calculation shown in the textbook's Example 4.3, but dualize the second constraint rather than the first.

2. Textbook exercise 4.8.

3. Textbook exercise 4.12 parts (a) and (b).

4. Show that the greedy heuristic applied to the maximum matching problem guarantees an approximation ratio of $\frac{1}{2}$, but not $\frac{1}{2} + \epsilon$ for any $\epsilon > 0$.

5. Using a mathematical software package such as MATLAB, generate 12 points in $\mathbb{R}^2$ by choosing each coordinate to be an integer uniformly at random in the range $[1, 100]$. Compute the matrix of pairwise distances between these points. (You can round the distances to the nearest integers.) Please include a computer printout showing the points and the pairwise distances.

Apply the Christofides heuristic to find a good tour through these points. Draw a picture illustrating the points, the minimum spanning tree, the matching edges and the found tour. Can you improve this solutions by exchanging a pair of vertices?

Additional Problems for Math 708

6. Consider the knapsack problem from the previous assignment:

$$\max \mathbf{x} \text{ s.t. } \quad x \in \{0,1\}^6, \quad 5x_1 + 3x_2 + 8x_3 + 9x_4 + 13x_5 + 8x_6 \leq 15.$$

Construct the Lagrangian dual with parameter λ by dualizing the knapsack constraint. Describe the Lagrangian dual function $Z(\lambda)$ as a piecewise linear function.

7. Textbook exercise 11.14.

The files used to produce your final solutions should be collected in an electronic archive (e.g. a .zip or .gz file) and e-mailed directly to him at `arafiey` at `sfu.ca`. Use files names of the form `hw5-7-stephen.dat`, replacing "stephen" with your own surname and extensions as appropriate. Make sure to include your final solution as well as the input files.

Schedule of graduate presentations

Each graduate student will present a brief introductory lecture on an additional topic in integer programming. This should contain substantial mathematical content and be understandable to the undergraduate students. The talks will be 20 minutes, followed by a 5 minute question period. Overheads will be submitted as part of the grading.

These talks will take place during the week of November 28th to December 1st. The tentative schedule and topics are as follows:

Monday, November 28th (early) **Michael Friesen**, Solving linear Diophantine equations (Chapter 2, Sections 2.1-2.3 in De Loera, Hemmecke and Köppe).

Monday, November 28th (late) **Jingxin Guo**, Mixed Integer Programming topic *to be determined*.

Wednesday, November 30th (early) **Michelle Spencer**, Presolve algorithms.

Wednesday, November 30th (late) **Rimi Sharma**, Mixed Integer Programming in Portfolio Optimization details *to be determined*.

Friday, December 2nd (early) **Aniket Mane**, Gröbner bases (Section 7.1 in textbook).

Friday, December 2nd (late) **Bolong He**, Robust discrete optimization (Section 14.1), time permitting with applications to inventory theory (Section 14.4).

Please let me know about any possible errors in this schedule.