

Optimization

WS 2013/14

Exercises 3

1. (PORTA – Polyhedron Representation Transformation Algorithm)

Install the PORTA package and read the manpages (http://typo.zib.de/opt-long_projects/Software/Porta/).

Given the following ILP:

$$\begin{array}{ll} \max & x_1 + x_2 + x_3 + x_4 \\ \text{w.r.t.} & \\ & x_1 + x_2 + x_3 \leq 2 \\ & x_1 + x_2 + x_4 \leq 2 \\ & x_3 + x_4 \leq 1 \end{array}$$

$$x_1, x_2, x_3, x_4 \text{ integral}$$

- Solve the LP relaxation with a solver (e.g lp-solve or our Clp demo program).
- Generate all feasible integral points using program *vint* (PORTA package).
- Transform the point representation into the halfspace representation using program *traf* (PORTA package).
- Solve the resulting linear program again with your lp solver.

2. Branch and Bound (NIVEAU I)

$$\begin{array}{ll} \max & 7x_1 + 10x_2 + 4x_3 + 5x_4 \\ \text{w.r.t.} & \\ & 6x_1 + 8x_2 + 4x_3 + 2x_4 \leq 15 \\ & x_1, x_2, x_3, x_4 \in \{0, 1\} \end{array}$$

- First install SCIP (<http://scip.zib.de/>). You can find an example, how to use SCIP, here: <http://scip.zib.de/doc/html/SHELL.shtml>
- Solve the LP relaxation with SCIP.
- Apply branch and bound to find the optimal solution to the ILP.
- check your solution with the help of SCIP.

3. Critical Mixed Cycles (NIVEAU II)

Prove the following lemma (see lecture script):

A subset $T \subseteq E$ is a trace, if and only if $G' = (V, T, H)$ does not contain a critical mixed cycle.

4. Branch and Cut (NIVEAU I)

Apply the cutting plane method to compute an optimal alignment of two sequences "ACCA" and "CACA" where a match scores 1 and a mismatch or gap scores 0:

- (a) Draw the alignment graph, the conflict graph, and the pair graph.
- (b) Now start with the trivial (relaxed) LP and add successively clique inequalities which you can find on the longest paths in the pair graph that is labeled with the solution of the last step. Repeat this until you get the optimal alignment.