Exercise 1. Apply the column generation algorithm to the following cutting stock problem:

- company stores rolls of length 218 cm,
- a customer has ordered 44 pieces of length 81 cm, 3 pieces of length 70 cm and 48 pieces of length 68 cm.

Exercise 2. Solve the following mixed integer linear program using Benders decomposition:

$$\begin{aligned} \text{maximize} -2x_1 - 2x_2 - 3y_1 - 4y_2 \\ x_1 - x_2 - 3y_1 + y_2 \leq -6, \\ -x_1 + 3x_2 - 2y_1 - 2y_2 \leq -5, \\ x, y \geq 0 \\ y_1 \leq 2, \\ y \in \mathbb{Z}^2. \end{aligned}$$

Exercise 3. Describe the optimal solution of the linear relaxation of an uncapacitated facility location problem.

Exercise 4. Use linear relaxation, greedy algorithm and local improvement to solve an instance of the uncapacitated facility location problem with

$$C' = \begin{pmatrix} 3 & 9 & 2 & 6 \\ 5 & 9 & 7 & 6 \\ 0 & 7 & 6 & 6 \\ 6 & 7 & 4 & 0 \end{pmatrix}, \qquad f = \begin{pmatrix} 3 \\ 2 \\ 3 \\ 3 \end{pmatrix}.$$

Exercise 5. Suggest how to choose the branching variable when solving a facility location problem using branch-and-bound.

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