Hardness of Multi-Stage Stochastic ILPs

Alexandra Lassota
alexandra.lassota@epfl.ch

Integer programs play an important role in theory and applications, but are hard to solve in general. In this project, we consider the special case of so-called multi-stage stochastic ILPs, which are recursively composed of 2-stage stochastic ILPs.

The constraint matrix $A$ of a 2-stage stochastic ILP has the following form:

$$A = \begin{pmatrix} A_1 & B_1 & 0 & \ldots & 0 \\ A_2 & 0 & B_2 & \ddots & \vdots \\ \vdots & \ddots & \ddots & \ddots & 0 \\ A_n & 0 & \ldots & 0 & B_n \end{pmatrix},$$

where $A_1, \ldots, A_n \in \mathbb{Z}^{t \times r}$ and $B_1, \ldots, B_n \in \mathbb{Z}^{s \times s}$ are integer matrices themselves.

In the multi-stage stochastic ILP problem, the $B_i$ matrices are (recursive) 2-stage stochastic matrices.

It is known that multi-stage stochastic ILPs can be solved in a running time involving a tower of exponents of height equal to the recursion depth $n$. Several lower and upper bounds for related settings are known, see [1,2,3,4] for an overview.

The goal of this project is to gather the current state-of-the-art lower and upper bounds and to understand the connection between them. Further, a (new) running time lower bound for the multi-stage stochastic ILPs is sought-after.

References