1 Parameterized Algorithm

1.1 Subtask 1

Prove the following Theorem:

For the MIN-MAX REGRET problem for $\mathcal{X}$ the optimal solution x^* corresponds to an optimal solution for its most favorable scenario $c^{+(x^*)}$ defined as

$$c^{+(x)}(e) = \begin{cases} c^+(e) & \text{if } x_e = 0 \\ c^-(e) & \text{if } x_e = 1. \end{cases}$$

1.2 Subtask 2

Prove the following Corollary:

If the number of nondegenerate intervals in $\mathcal{U}_I$ is d, the MIN-MAX REGRET robust optimization problem for $\mathcal{X}$ can be solved using 2^d calls to the classic linear optimization problem for $\mathcal{X}$.

2 Min-Max Regret Assignment Problem

Show that there exists a MIP (mixed integer programming) formulation for the min-max regret assignmnet problem.

3 Min-Max-Regret Shortest Path

3.1 NP-hardness

Prove that the min-max regret shortest path problem with interval uncertainties is NP-hard (note that all costs in the reduction should be non-negative).

3.2 MIP algrithm

Check if the ideas to obtain an efficient MIP for the min-max regret spanning tree problem from the lecture video can be adapted to the min-max regret shortest path problem.