

# Optimization and Simulation

## Questions and discussions

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# Discrete optimization

## Problem

$$\min c^T x + d^T y$$

subject to

$$\begin{aligned} A^T x + B^T y &= b \\ x, y &\geq 0 \\ y &\in \mathbb{N}. \end{aligned}$$

## Proposed algorithm

- 1 Solve the relaxation.
- 2 Round the solution to the nearest integer.

What potential problems are we facing?

# Local optimum

In continuous optimization,  $x^*$  is local minimum of a function  $f$  if there exists  $\varepsilon > 0$  such that

$$f(x^*) \leq f(x) \forall x \text{ such that } \|x - x^*\| \leq \varepsilon.$$

What is the definition in discrete optimization?

# Multi-objective optimization

If you need to solve a multi-objective optimization problem, what would you do?

- Combine all objectives into one using weights.
- Use lexicographic optimization.
- Use constrained optimization.
- Use a heuristic to build the Pareto frontier.
- Use goal programming.

# Metropolis-Hastings algorithm

The algorithm assumes time reversibility of the Markov chain, so that

$$\pi_i P_{ij} = \pi_j P_{ji}.$$

Why do we need it? Is it sufficient? Necessary?

# Simulated annealing

Link between optimization and simulation.