Poster Session Blitz
April 25, 2023

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Preliminaries

Let $A \in \mathbb{Z}_+^{m \times n}$, $G \in \mathbb{Q}_+^{m \times p}$, and $b \in \mathbb{R}_+^m$. Assume cost vectors $c, h > 0$.

Consider the mixed-integer programming (MIP) problem:

$$z_{MIP}(b) := \max_{x \in \mathbb{Z}_+^n, y \in \mathbb{R}_+^p} \{c^\top x + h^\top y \mid Ax + Gy \leq b\}. \tag{MIP}$$

And its LP relaxation:

$$z_{LPR}(b) := \max_{x \in \mathbb{R}_+^n, y \in \mathbb{R}_+^p} \{c^\top x + h^\top y \mid Ax + Gy \leq b\}. \tag{LPR}$$

This is joint work with Dr. Tayo Ajayi and Dr. Andrew J. Schaefer. This research was supported by NSF grant CMMI-1933373.

Periodicity of Absolute MIP Gap Functions

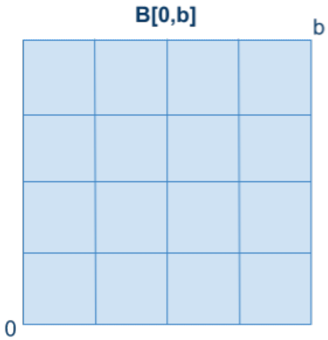
Definition

Given a set of RHSs, $\mathcal{B}[0, \mathrm{b}] = \prod_{i=1}^{m}[0, b_i]$, the **Absolute** Gap Function for MIPs is defined as:

$$\mathbf{\Gamma} : \mathcal{B}[0, \mathrm{b}] \to \mathbb{R}_+ \cup \{\infty\}, \ \mathbf{\Gamma}(\widehat{\beta}) := z_{LPR}(\widehat{\beta}) - z_{MIP}(\widehat{\beta}).$$

Theorem

Let a_j *be the* j^{th} *column of* A *and* g_k *be the* k^{th} *column of* G. *Then,* ***under certain conditions***, $\mathbf{\Gamma}(\widehat{\beta} - \eta \mathrm{a}_j - \lambda \mathrm{g}_k) = \mathbf{\Gamma}(\widehat{\beta})$.



Enhancing classification and regression trees via mathematical optimization

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Trends in Computational Discrete Optimization at Providence, USA

April 25th 2023

Mathematical Optimization

Machine Learning

Optimal Classification and Regression Trees

- We develop a Continuous Optimization formulation.
- We model probabilistic (as opposed to deterministic) splitting rules.

Prediction accuracy

Sparsity

Cost-sensitivity

Fairness

Local explainability

Data complexity

Thank you for your attention!

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All this research is available at:

https://www.researchgate.net/profile/Cristina_Molero-Rio

An analysis of alternative perspective reformulations for piecewise-convex optimization

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Poster

1. Introduction
   - Sequential Convex MINLP
2. Formulations for SC-MINLP
   - Incremental Model (IM)
   - Multiple Choice Model (MCM)
   - Convex Combination Model (CCM)
3. Comparison
   - Theoretical
   - Computational results

Thank you!

Pre-Trained Solution Methods for Unit Commitment

Nagisa Sugishita, Andreas Grothey, Ken McKinnon
University of Edinburgh

April 2023

Pre-Trained Solution Methods for Unit Commitment

- Find the optimal operation of generators given demand ω:

$x =$ (on-off status , power output)

on-off status

0.0	0.0	1.0	0.0
1.0	1.0	1.0	0.0
1.0	1.0	1.0	1.0

← time period →

power output

0.0	0.0	0.4	0.0
0.2	0.5	0.6	0.0
0.8	1.0	1.0	0.8

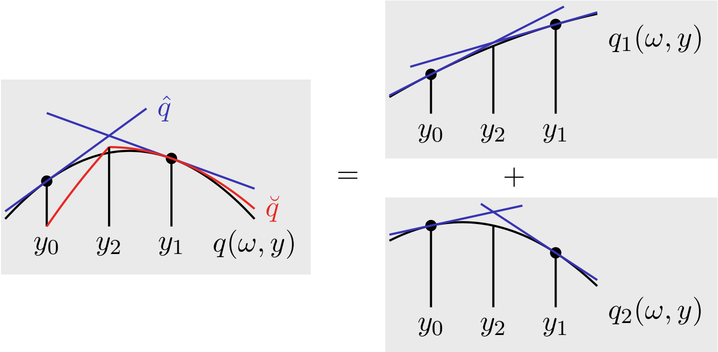
← time period →

- The dual problem is decomposable by generators

$$\max \left\{ q(\omega, y) := \frac{1}{G} \sum_{g=1}^{G} q_g(\omega, y) \right\},$$

where G is the number of generators.

Improvement on Regularised Cutting-Plane Method



1. How should initialise the algorithm, i.e. get y_0?
   - Use machine learning to find a good point.
2. How should we accelerate the progress of the algorithm?
   - Only evaluate a subset of $q_g(\omega, y)$ and take incremental steps.

Schur numbers

Question

What is the **smallest** *n such that every k-coloring of $\{1, 2, \ldots, n\}$ produces a* **monochromatic** *solution to $x + y = z$?*

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This smallest n is called the **Schur number** $S(k)$.

- $S(2) = 5$

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- $S(3) = 14$:

  1 2 3 4 5 6 7 8 9 10 11 12 13

Schur numbers

Table of all known Schur numbers:

k	$S(k)$	proof author/year	proof computation time
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- Heule's proof relies on sophisticated **SAT solving** techniques and a massive computation.
- Longest proof in history!
- Our goal: study generalizations of Schur numbers called **Rado numbers** using SAT solvers