

通用MIP求解技术

MIP:混合整数(线性)规划

通用MIP求解技术

- Presolve: 缩减MIP问题规模+提升MIP问题下界
- Primal Heuristics: 高效获取MIP问题高质量上界
- Cuts: 提升MIP问题下界
- Branch: Divide and Conquer思想的体现
- LP relaxation: 线性规划是基础

Overview

We will briefly talk about **primal heuristics for MIP**, and order them based on how **expensive** they are.

| | LP-Free | LP-Based | MILP-Based |
|----------------------|---|--|--|
| Starting Heuristics | Feasibility Jump Fix-and-Propagate Shift-and-Propagate Walk-SAT Local-ILP | Rounding Diving Heuristic Feasibility Pump OCTANE | Zero-Obj RENS |
| Improving Heuristics | 1-OPT 2-OPT Tabu Search LNS Adaptive LNS | | RINS Local branching Crossover DINS GINS |

Computational Costs

Overview

We will briefly talk about **cuts for MIP**

| | General-purpose | Structure |
|------|--|--|
| Cuts | Gomory cuts Mixed integer rounding cuts Strong Chvatal-Gomory cuts Zero-half cuts Mod-k cuts Disjunctive cuts Lift-and-project cuts Conflict cuts Reformulation-linearization techniques cuts Relax-and-lift cuts Learned cuts Reduced cost strengthening | Cover cuts Flow cover cuts GUB cuts Implied bound cuts Clique cuts Network cuts |

Overview

We will briefly talk about **Branch for MIP**

| Branch | Most Infeasible Branching Least Infeasible Branching Pseudocost Branching Strong Branching Hybrid Branching Reliability Branching Inference Branching |
|---------------|---|

Overview

We will briefly talk about **Presolve for MIP**

| | Fast | Medium | Exhaustive |
|--------------|--|---|--|
| LP Presolve | | | |
| MIP Presolve | Coefficient tightening Domain propagation Column singleton | Dual fix Fix continuous Parallel columns Parallel rows Simple probing Stuffing | Dominated column Implied integer Probing Sparsity Substitution |

Computational Costs →

通用MIP求解技术重要性

- Presolve: 20%-30%
- Primal Heuristics: 5-10%
- Cuts: 40-50%
- Branch: 10-50%
- LP relaxation: 15-20%

通用LP求解算法

- Simplex method:
- Dual Simplex method:
- Interior-Point method(Barrier):
- PDLP/cu-PDLP(First-order method):
- Shifting(Column Generation):
- Network Simplex:
- Concurrent: