Zuse Institute Berlin
Department Optimization

SCIP – Solving Constraint Integer Programs

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Constraint Integer Program

$$\min \quad c^T x$$
$$s.t. \quad x \in F \subseteq \mathbb{R}^n$$
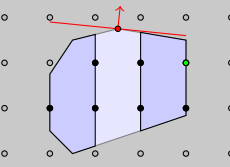$$x_j \in \mathbb{Z} \ \forall \, j \in I$$

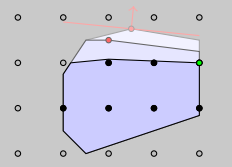After fixing all integer variables, the remaining problem has to be an LP.

Constraints

F is described via constraints. These may be

▷ linear: $a^T x \leq b$
▷ integer: $x_j \in \mathbb{Z}$
▷ logical: $\neg x_1 \vee x_2 \Rightarrow x_3$
▷ combinatorial: $nosubtour(x, G)$
▷ general: $alldiff(x_1, \ldots, x_k)$
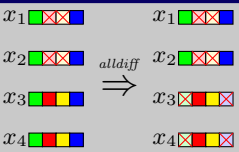
Branch-and-Bound

Cutting Planes

Solving Methods
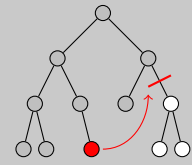
SCIP is a branch-cut-and-price framework. It combines solving methods from

▷ MIP: cutting planes
▷ CP: domain propagation
▷ SAT: conflict analysis

and uses branch-and-bound.

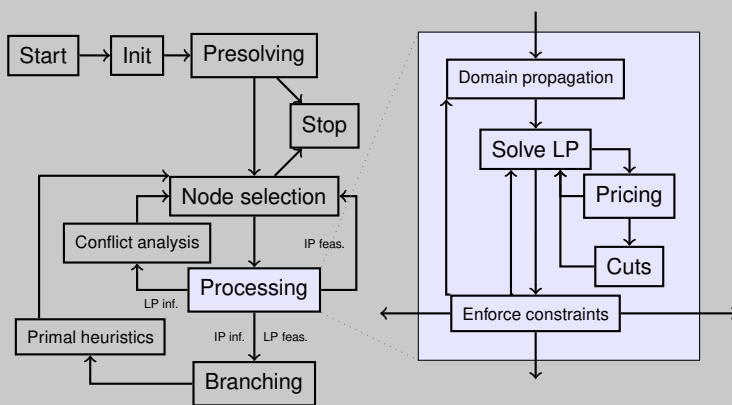## Domain Propagation

x_1
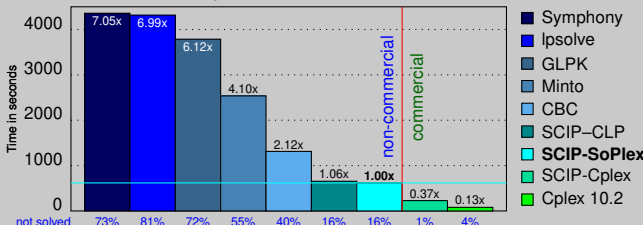x_2 $\xrightarrow{alldiff}$ x_2
x_3
x_4

Conflict Analysis

SCIP as a MIP-Solver

Start → Init → Presolving
Stop
Node selection
Conflict analysis
Processing   IP feas.
LP inf.
Primal heuristics   IP inf.   LP feas.
Branching

Domain propagation
Solve LP
Pricing
Cuts
Enforce constraints

Performance

SCIP is a very fast non-commercial MIP-solver.

Time in seconds

4000
3000
2000
1000
0

7.05x   6.99x   6.12x   4.10x   2.12x   1.06x   1.00x   0.37x   0.13x

non-commercial | commercial

■ Symphony
■ lpsolve
■ GLPK
■ Minto
■ CBC
■ SCIP–CLP
■ **SCIP–SoPlex**
■ SCIP-Cplex
■ Cplex 10.2

not solved   73%   81%   72%   55%   40%   16%   16%   1%   4%

SCIP 1.00 is available under: http://scip.zib.de

Cooperation

Technische Universität Darmstadt

SIEMENS