A generic framework to parallelize branch-and-bound based solvers (e.g., MIP, MINLP, ExactIP) in a distributed or shared memory computing environment.

- Exploits powerful performance of state-of-the-art “base solvers”, such as SCIP, CPLEX, etc.,
- without the need for base solver parallelization.

**Parallel search tree generated by UG**

- Base solver 1
- Base solver 2
- Base solver 3
- Base solver 4
- Base solver 5
- Base solver 6
- Base solver 7
- Base solver 8
- Base solver 9
- Base solver 10
- Base solver 11
- Base solver 12

**Current projects**

- ParaSCIP: ugr[SCIP, MPI]
  - Uses CIP solver SCIP
  - Used to investigate a large scale parallelization
  - Runs on up to 7,168 cores at supercomputer HLRN II
- FiberSCIP: ugr[SCIP, OpenMP]
  - Uses CIP solver SCIP
  - Enables parallelization on single desktop computers
- ParaCPLEX: ugr[CPLEX, MPI]
  - Uses MIP solver CPLEX

**Current results of ParaSCIP (ug[SCIP, MPI])**

The following open instances from MIPLIB2003 were solved to optimality the first time:

- ds - 656 constraints, 67,732 binary variables
  - [Run 1] solved in ~86 hours (restarted from checkpoint 16 times) using up to 2,048 cores
  - [Run 2] solved by a single job with 4,096 cores in ~76 hours
- stp3d - 159,488 constraints, 204,880 binary variables
  - after applying SCIP presolving 9 times, problem was reduced to 88,388 constraints and 123,637 binary variables
  - [Run 1] solved in ~114 hours (restarted from checkpoint 10 times) using up to 2,048 cores
  - [Run 2] proved optimality of solution using a single job with 4,096 cores in ~44 hours
  - [Run 3] proved optimality of solution using a single job with 7,168 cores in ~92 hours

Computed optimal solutions for 50-10v, probportfolio, reblock364, rmatr200-p20, dg012142, dclc, germany50-DBK from MIPLIB2010.

**New features**

- Can handle both MIPs and MINLPs (Beta version is released as a part of the SCIP Optimization Suite)
- Deterministic mode for debugging

**Abstraction of base solvers and communication libraries**

Small and simple interfaces between:

- UG framework and base solver
- UG framework and communication library

A parallel solver instantiated by UG framework is named:

ug[Base Solver, Communication library]