Toolbox for **generating** and **solving** constraint integer programs

### ZIMPL
- a mixed integer programming modeling language
- easily generate LPs, MIPs, and ...

### SCIP
- a MIP and CP solver, branch-cut-and-price framework
- ZIMPL models can directly be loaded into SCIP and solved

### SoPlex
- a linear programming solver
- SCIP uses SoPlex as underlying LP solver
ZIMPL – Modeling Language

- distinguish between data and model
- easily generate LPs, MIPs, and ...
- fast prototyping
- http://zimpl.zib.de
- AIMMS, AMPL, GAMS, MOSEL, OPL, ...

SoPlex – Linear Programming Solver

- dual and primal simplex
- has a warm start
- http://soplex.zib.de
- CLP, CPLEX, GUROBI, MOSEK, XPRESS, ...
SCIP is a framework for Constraint Integer Programming oriented towards the needs of Mathematical Programming experts who want to have total control of the solution process and access detailed information down to the guts of the solver.

- framework to solve constraint integer programs
- branch-and-bound framework
- branch-and-cut framework
- branch-and-propagate framework
- branch-and-price framework
- black box MIP solver
- http://scip.zib.de
- CBC, CPLEX, GUROBI, MOSEK, XPRESS, ...
SCIP App

Run SCIP on instance /sdcard/miplib/fiber.mps
Calling SCIP with instance /sdcard/miplib/fiber.mps and
display_width 60
SCIP version 1.2.1.3 [precision: 8 byte] [memory: block]
[node: optimized] [LP Solver: Cgl] [listable] [Expression
interceptor: NONE]
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Informationstechnik Berlin (ZIB)
attempt reading instance <sdcard/miplib/fiber.mps>
original problem has 1298 variables (1254 bin, 0 int, 0
impl. 44 cont) and 363 constraints
presolving:
(round 1) 111 del vars, 67 del cons, 59chg bounds, 0chg
sides, 0chg coeffs, 0upgd cons, 106impls, 33clqs
(round 2) 112 del vars, 68 del cons, 59chg bounds, 52chg
sides, 6chg coeffs, 0upgd cons, 106impls, 35clqs
(round 3) 207del vars, 33 del cons, 59chg bounds, 55chg
sides, 13chg coeffs, 0upgd cons, 106impls, 35clqs
(round 4) 243 del vars, 73 del cons, 59chg bounds, 25chg
sides, 15chg coeffs, 74upgd cons, 106impls, 35clqs
(round 5) 243 del vars, 74 del cons, 68chg bounds, 35clqs
sides, 13chg coeffs, 74upgd cons, 106impls, 35clqs
(round 6) 252 del vars, 74 del cons, 68chg bounds, 35clqs
presolving (7 rounds):
252 deleted vars, 74 deleted constraints, 68tightened
bounds, 0 added holes, 55 changed sides, 13 changed
coefficients
106impllications, 35clqs
presolved problem has 1046 variables (1046 bin, 0 int, 0
impl. 4 cont) and 289 constraints
38constraints of type <nmapack>
35 constraints of type <setpcc>
210 constraints of type <linear>
transformed objective value is always integral (scale: 0.01)
Presolving Time: 0.44

<table>
<thead>
<tr>
<th>node</th>
<th>left</th>
<th>dualbound</th>
<th>primalbound</th>
<th>gap</th>
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<td>3.843178e+06</td>
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<td>2.675168e+06</td>
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<tr>
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<td>605.57%</td>
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<tr>
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<td>1.435826e+06</td>
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<td>3.791518e+05</td>
<td>2.675168e+06</td>
<td>605.57%</td>
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</tbody>
</table>
fastest non-commercial MIP solver

MIPLIB 2010, results by H. Mittelmann (14.8.2011)
Some universities and institutes using the ZIB Optimization Suite:
Linux and Mac users

- download the ZIB Optimization Suite 2.0.1
  http://zibopt.zib.de
- read the INSTALL
  ```
  tar xvf ziboptsuite-2.0.1.tgz
  cd ziboptsuite-2.0.1
  make
  make test
  ```
- requirements: readline and zlib
- you can also use the virtual machine (see next slide)
Windows user

- download the virtual machine (VM) form the course web page
  - CIPvmware.zip (Attention 2.7 GB)
  - >1 GB main memory
  - 5–8 GB disk space

- follow the instruction stated in the README.txt
  - download the VMware Player (free software)
  - load the VM into the VMware Player
  - power on the VM

- ZIB Optimization Suite is already installed
- Eclipse, emacs, \LaTeX, JAVA, Kate, Kile, ...
Questions
Definition

The **binpacking problem** consists of assigning sized items to bins of given capacities such that the total number of used bins is minimized.
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