

## Computational Integer Programming <br> Lecture 2

Zuse Institute Berlin (ZIB)

## DFG Research Center Matheon Mathematics for key technologies

## ZIB Optimization Suite $=$ SCIP + SoPlex + ZIMPL

Toolbox for generating and solving constraint integer programs

## ZIMPL

$\triangleright$ a mixed integer programming modeling language
$\triangleright$ easily generate LPs, MIPs, and ...

## SCIP

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

## SoPlex

$\triangleright$ a linear programming solver
$\triangleright$ SCIP uses SoPlex as underlying LP solver

## ZIMPL + SoPlex

## ZIMPL - Modeling Language

$\triangleright$ distinguish between data and moel
$\triangleright$ easily generate LPs, MIPs, and ...
$\triangleright$ fast prototyping
$\triangleright$ http://zimpl.zib.de
$\triangleright$ AIMMS, AMPL, GAMS, MOSEL, OPL, ...

SoPlex - Linear Programming Solver
$\triangleright$ dual and primal simplex
$\triangleright$ has a warm start
$\triangleright$ http://soplex.zib.de
$\triangleright$ 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.
$\triangleright$ framework to solve constraint integer programs
$\triangleright$ branch-and-bound framework
$\triangleright$ branch-and-cut framework
$\triangleright$ branch-and-propagate framework
$\triangleright$ branch-and-price framework
$\triangleright$ black box MIP solver
$\triangleright$ http://scip.zib.de
$\triangleright$ CBC, CPLEX, GUROBI, MOSEK, XPRESS, ...

## SCIP App



## B

## ScipApp <br> /sdcard/miplib/fiber.mps

in SciP on instance /sdeard/miplib/fiberifitiber.aps and calling scip with instance /sacara.wdisplay width 60
 scip version 1.2, it

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ore wond-zuse-zentrua fuer
copyright (C) ${ }^{2002}$-2010 Berlin (ZIB)
informationstectinik berce </sdicard/miplib/fiber.ppsp
atteept reading instance elsccardiapion 1295 variables ( 1254 bin, 0 int, 0 original problea nas 463 constraints
1mpl, 44 cont) and 365 (comstrants
presolving:
(round i) ill del vars, 67 del conss, 39 chs bounds, 0 tides, ochs coeffs, o upgd conss, $106 \frac{1 \text { topls, } 33 \text { ciq }}{52}$ chy (round 2) 112 del vars, 69 del conss, 59 ans bons 15 cias

 Ides. 13 chs coefts, 0 upgo conss, 24 del vars, 73 del conss, 59 chs bounds, 15 ch (round 4) 243 del vars ${ }^{24}$ deel conss, 106 10815, 33 c1eg ap
 (round 5$)^{243}$ del vars, 74 upgd conss, 106 ithis, 33 cless 13 chs coeffs,
 (rouns is chs coeffs, 74 upgd conss, 108 inpls, 33 cig presolving (9) rounds:
presolving 252 delef vars, 74 deleted constraints, is tishtemed hounds. 0 added holes, 53 changed sides, is chmes. coefficients
106 inplications, 35 cliques
presolved problen has 1046 varkables ( 1046 bin, 0 int, 0 1mpl, o cont) and 289 constraints

38 constraints of type eknapsack
35 constraints of type ssetppes
216 constraints of type slinears
transforsed objective value is almoys integral (senle: 0.01 Presolving Time: 0.44

## Computational results

$\triangleright$ fastest non-commercial MIP solver

results by H. Mittelmann (16.1.2011)


MIPLIB 2010, results by H. Mittelmann (14.8.2011)

Some universities and institutes using the ZIB Optimization Suite:


## ZIB Optimization Suite $=$ SCIP + SoPlex + ZIMPL

## Linux and Mac users

$\triangleright$ download the ZIB Optimization Suite 2.0.1 http://zibopt.zib.de
$\triangleright$ read the INSATLL

- tar xvf ziboptsuite-2.0.1.tgz
- cd ziboptsuite-2.0.1
- make
- make test
$\triangleright$ requirements: readline and zlib
$\triangleright$ you can also use the virtual machine (see next slide)


## ZIB Optimization Suite $=$ sCIP + SoPlex + ZIMPL

## Windows user

$\triangleright$ 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
$\triangleright$ 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
$\triangleright$ ZIB Optimization Suite is already installed
$\triangleright$ Eclipse, emacs, ATEX, JAVA, Kate, Kile, ...


## Questions

## Binpacking Problem

## Definition

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


Items

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Items


Assignment

