

# MiniZinc Challenge 2010



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# What is the MiniZinc Challenge



- Comparing Constraint Programming Solvers
- ~10 problems + ~100 problem instances
- 3 categories
  - fixed search: must follow a given search strategy
  - free search: search anyway you want
  - parallel search: shared memory **dual-core** (free) search
    - non parallel solver use free results
- Purse based scoring: 100 points per instance
  - split by speed of finding solution/proving optimality
  - quality of best solutions found (minimization)

# The problems



- Satisfaction and Optimization problems
- All problems are new, not previously used in MiniZinc challenge and preferably the models not seen before.
  - Submitted by contestants
  - Suggested by judges
  - Developed by G12 group
- Problems and number of instances selected by judges
  - instances selected randomly

# The problems



- **Balanced academic curriculum [15]**
  - minimization, linear + reified linear
- **Costas Array [5]**
  - satisfaction, alldifferent
- **Depot Placement [15]**
  - minimization, alldifferent, element, linear+reified linear
- **Filter Scheduling [10]**
  - satisfaction, diffn
- **Crossing Minimization [5]**
  - minimization, Boolean

# The problems



- Ghoulomb (evil golomb rulers) [10]
  - minimization, cumulative
- Grid colouring [5]
  - minimization, disjunction + reified equality
- RCPSP\_max (resource scheduling) [10]
  - minimization, cumulative
- Solitaire Battleships [15]
  - satisfaction, reified expressions
- Waste Water Treatment Plant Scheduling [10]
  - satisfaction, linear, disjunction + reified equality

# The contestants



- Gecode [**Fixed**, **Free**, **Par**]
  - winner of all categories of last 2 challenges
- JaCoP [**Fixed**]
  - java based CP solver
- fzn2smt [**Free**]
  - translator from FlatZinc to SMTlib + SMT solver Yices
- SCIP [**Free**]
  - MIP solver with propagation and learning
- fzntini [**Free**]
  - Translation to SAT increasing integer sizes

# G12 solver entries



- Cplex [Free, Par]
  - Cplex 12.1 applied to a linearization written in MiniZinc
- G12FD [Fixed, Free]
  - G12 finite domain solver
- Chuffed [Fixed, Free, Par]
  - New lazy clause generation solver

# Unfairness?



- Linearization failed for some models
  - affects `Cplex` + `SCIP`
- Decomposition blew out for some models
  - affects `Cplex`, `fzntini`, `fzn2smt`
- `fzn2smt` doesn't appear to return answers as found (so loses potential points)



# Results: Fixed



- Chuffed, Gecode, G12FD, JaCoP
- G12FD: **1207**
- JaCoP: **1579**
- Gecode: **2133**
- Chuffed: **4680**

# Results: Free



- Chuffed, Cplex, fzn2smt, fzntini, G12FD, Gecode, JaCoP, SCIP
- SCIP: **289**
- Cplex: **387**
- G12FD: **525**
- fzntini: **905**
- JaCoP: **961**
- fzn2smt: **1719**
- Gecode: **1771**
- Chuffed: **3341**

# Results: Parallel



- `Chuffed`, `Cplex`, `fzn2smt`, `fzntini`, `G12FD`,  
`Gecode`, `JaCoP`, `SCIP`
- `SCIP`: 326
- `Cplex`: 500 (+113)
- `G12FD`: 556
- `fzntini`: 901
- `JaCoP`: 997
- `Gecode`: 1871 (+100)
- `fzn2smt`: 1873
- `Chuffed`: 2872 (-469)

# Parallel:



- Cplex-free: 1209 vs Cplex-par: 1190
- Chuffed-free: 5252 vs Chuffed-par: 4347
- Gecode-free: 3105 vs Gecode-par: 3994

# The winners:



- **Fixed:** Gecode, JaCoP
- **Free:** Gecode, fzn2smt, JaCoP
- **Parallel:** fzn2smt, Gecode, JaCoP
  
- **Many thanks to our judges**
  - Jimmy Lee
  - Barry O'Sullivan
  - Roland Yap

- Immature (for CP) solvers
  - SCIP and CPLEX + linearization
  - fzn2smt

Next year they will do **better!**

- More CP Solvers
  - ECLiPSe + SICStus
  - others promised me entries at last CP!
- Rethink scoring?

# Future of Constraint Programming?



MIP

Constraint  
Programming

SAT  
SMT

# Pessimistic



Modelling layer

MIP

Constraint  
Programming

SAT  
SMT



# Optimistic



MIP

Constraint  
Programming

SAT  
SMT

- mzn2fzn translator
  - specializable to each FlatZinc backend
- MiniZinc IDE (Eclipse based)
- Flatzinc conformance test suite
- Large suite of benchmarks
- FlatZinc parser: yacc/lex
- XML version of FlatZinc (and converters)
- Courseware (some)

- Get MiniZinc 1.1.6
  - <http://www.g12.csse.unimelb.edu.au/minizinc/>
- Add some MiniZinc models to the Wiki
  - <http://www.g12.csse.unimelb.edu.au/wiki/>
- Positions available at G12 immediately: talk to
  - Peter Stuckey: [peter.stuckey@nicta.com.au](mailto:peter.stuckey@nicta.com.au)
  - Mark Wallace: [mgw@infotech.monash.edu.au](mailto:mgw@infotech.monash.edu.au)
- PhD scholarships available from NICTA!