# XCSP3 Competition 2017
# – Results –

http://www.cril.fr/XCSP17/

presented by Christophe Lecoutre

23rd International Conference
Principles and Practice of Constraint Programming

August 30, 2017

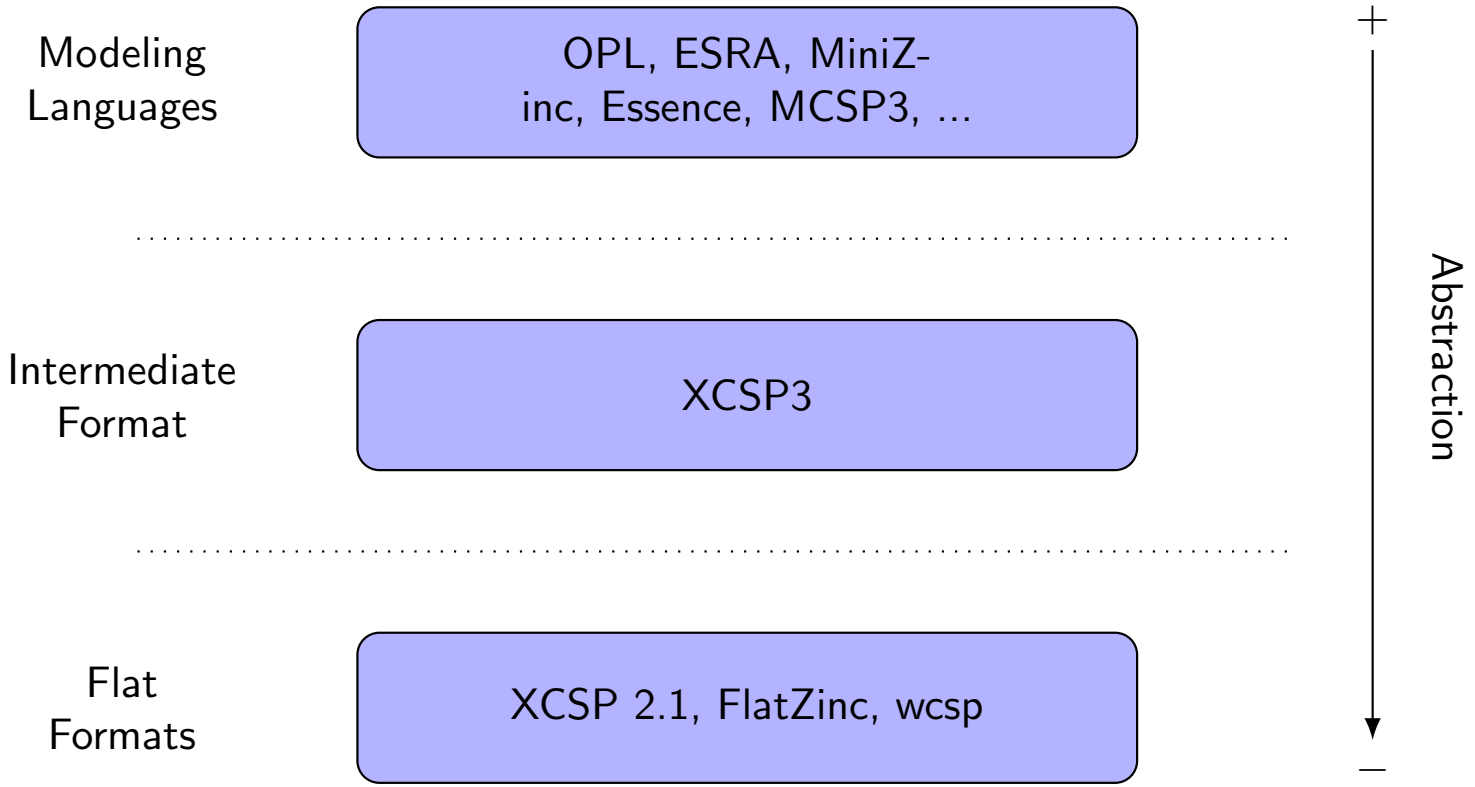
XCSP3 is:

- an XML-based format designed to represent instances of combinatorial constrained problems
- an intermediate integrated format preserving the structure of the models

XCSP3 is a major extension of XCSP 2.1 since it allows us to deal with:

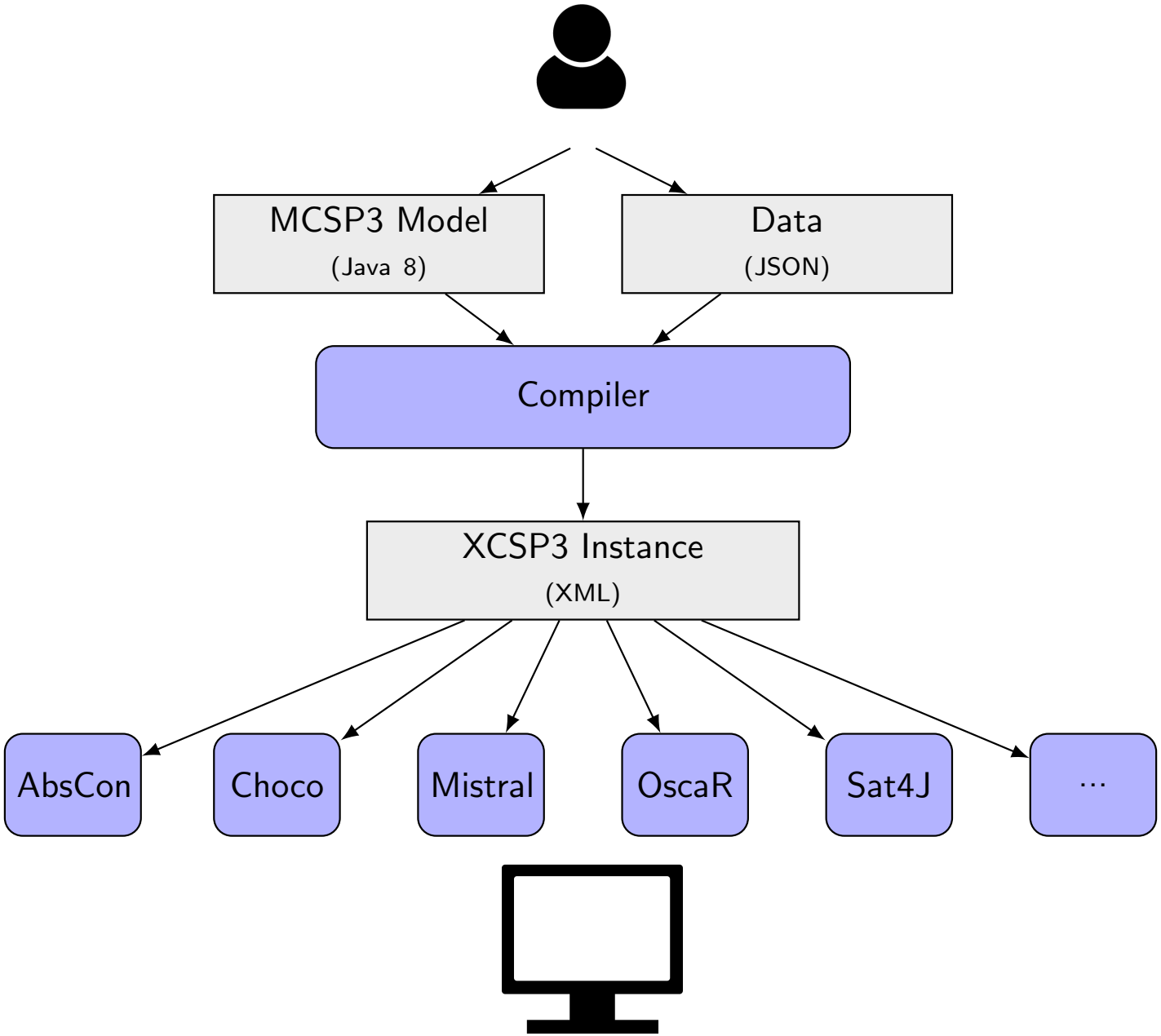
- mono/multi optimization
- many types of variables
- cost functions
- reification and views
- annotatons
- variable quantification
- distributed, probabilistic and qualitative reasoning

# XCSP3: an Intermediate Format




www.xcsp.org

# XCSP3: the central piece of a Modeling/Solving process



# XCSP3: Available Tools and Benchmarks

Many tools are available on github:

*https://github.com/xcsp3team/*.

Parsers available on github:

- Java 8 Parser
- C++ 11 Parser

Various tools for:

- checking solutions and bounds: org.xcsp.checker.SolutionChecker
- checking the validity of an instance for a competition track: org.xcsp.checker.CompetitionChecker
- checking the validity of an XCSP3 instance (made available soon)

Many series of CSP/COP instances that can be downloaded from `www.xcsp.org` by means of our selection engine!

# Purpose of Competitions

The goal of a competition is to:

- evaluate solvers in the same conditions
- help collecting publicly available benchmarks and data (results, traces, ...)
- help the community identify good ideas and strange results: the goal is to raise questions and get new ideas!

Competitions should not be misunderstood:

- The results are not an absolute truth: they depend on the benchmark selection, experimental conditions, ...
- A competition is not limited to a ranking: rankings are just an over-simplified view, but still relevant to motivate authors
- Competitions must be driven by the community: benchmark submission/selection advices, suggestions for improvements, ...

# Tracks for the 2017 XCSP3 Competition

There are 6 Standard tracks and two Minisolver tracks.

| Problem | Goal | Exploration | Timeout |
|---|---|---|---|
| CSP | one solution | sequential | 40 minutes |
| CSP | one solution | parallel | 40 minutes |
| COP | best solution | sequential | 4 minutes |
| COP | best solution | parallel | 4 minutes |
| COP | best solution | sequential | 40 minutes |
| COP | best solution | parallel | 40 minutes |

Table: Standard Tracks.

| Problem | Goal | Exploration | Timeout |
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Table: Mini-Solver Tracks.

# Perimeter of Constraints (mainly, XCSP3-core)

For the standard tracks:

- `intension`, `extension`
- `regular` and `mdd`
- `allDifferent`, `allEqual`, `ordered` and `lex`
- `sum`, `count`, `nValues` and `cardinality`
- `maximum`, `minimum`, `element` and `channel`
- `noOverlap` and `cumulative`
- `instantiation`
- `slide`

For the Mini-solver tracks:

- `intension`, `extension`
- `allDifferent`
- `sum`
- `element`

# Computer Infrastructure

- The cluster we used is provided by CRIL and is composed of nodes with two quad-cores (Intel @ 2.67GHz with 32 GiB RAM).
- Hyperthreading was disabled for the final runs.
- Sequential solvers were run on one processor (4 cores) and were allocated 15500 MiB of memory.
- Parallel solvers were run on two processors (8 cores) and were allocated 31000 MiB of memory.
- The time limit can be understood either as a CPU limit, or as a WCK (wall-clock) limit.
- Sequential solvers are best compared with a CPU time limit.
- If it is assumed that CPU cores come for free (which is quite a strong assumption), both sequential and parallel solvers can be interestingly compared with a WCK time limit.

# Committees for the 2017 XCSP3 Competition

- Organization

| | |
|---|---|
| CRIL | Christophe Lecoutre, Cédric Piette and Olivier Roussel |
| ICTEAM | Pierre Schauss |
| I3S | Arnaud Malapert |
| LS2N | Charles Prudhomme |

- Judges
  - Claude-Guy Quimper from Université Laval, Québec, Canada
  - Helmut Simonis from Insight Centre for Data Analytics, Cork, Ireland
  - Christine Solnon from INSA, Lyon, France

# Selection of Instances

After a few iterations, the jury has:

- decided how many instances should be selected in each available series of instances (from xcsp.org)
- chosen to randomly select instances in each series

For this first edition, we had to fix some problems (notably, the tool org.xcsp.checker.CompetitionChecker was developped late).

Finally, the selection is as follows:

- Standard tracks: 510 CSP and 439 COP instances
- Mini-solver tracks: 242 CSP and 117 COP instances

# Handling Submissions and Ranking

Olivier Roussel managed the submission of solvers.

- Bugged solvers were allowed to resubmit (up to several times, during summer).
- At any moment, no contestant had access to the selection of the instances (managed by the jury and Olivier).
- Olivier has strong experience in the organisation of competitions (and is the developper of the competition infrastructure).

**Ranking.** based on the number of times a solver is able to give the best known answer (satisfiability, optimality, best known bound).

# Teams/Solvers

In alphabetic order:

| | |
|---|---|
| AbsCon-basic | C. Lecoutre |
| BTD 2017-08-10 | P. Jégou, H. Kanso, C Terrioux |
| Concrete 3.4 | J. Vion |
| Mistral-2.0 | E. Hebrard and M. Siala |
| Naxos 1.1.0 | N. Pothitos |
| OscaR ALNS, COS, Hybrid | OscaR Team |
| OscaR - Parallel with EPS | OscaR Team |
| choco-solver 4.0.5 | C. Prud'homme and J.-G. Fages |
| choco-solver 5a | C. Prud'homme and J.-G. Fages |
| cosoco (sat) 1.12 | G. Audemard |
| cosoco-mini 1.12 | G. Audemard |
| miniBTD | P. Jégou, H. Kanso, C. Terrioux |
| sat4j-CSP | D. Le Berre, E. Lonca |

# CSP - sequential - CPU - 40 minutes (510 instances)

| Rank | Solver | #solved | SAT/UNSAT | %inst. | %VBS |
|---|---|---|---|---|---|
| | *Virtual Best Solver (VBS)* | 420 | 297 / 123 | 82% | 100% |
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| 1 | **choco-solver 4.0.5 //** | 145 | 33% | 91% |
| 2 | **OscaR - // with EPS** | 135 | 31% | 84% |
| 3 | Mistral-2.0 | 133 | 30% | 83% |
| 4 | OscaR - Conflict Ord. | 125 | 29% | 78% |
| 5 | AbsCon-basic | 117 | 27% | 73% |
| 6 | choco-solver *4.0.5 seq* | 115 | 26% | 72% |
| 7 | OscaR - Hybrid | 109 | 25% | 68% |
| 8 | choco-solver *5a* | 106 | 24% | 66% |
| 9 | Concrete *3.4* | 103 | 24% | 64% |
| 10 | cosoco *1.12* | 98 | 22% | 61% |
| 11 | cosoco-sat *1.12* | 98 | 22% | 61% |
| 12 | sat4j-CSP | 77 | 18% | 48% |

# COP - sequential - CPU - 4 minutes (438 instances)

| Rank | Solver | #solved | %inst. | %VBS |
|---|---|---|---|---|
| | *Virtual Best Solver (VBS)* | 144 | 33% | 100% |
| 1 | OscaR - Conflict Ord. | 119 | 27% | 83% |
| 2 | Mistral-2.0 | 115 | 26% | 80% |
| 3 | choco-solver *4.0.5 seq* | 103 | 24% | 72% |
| 4 | AbsCon-basic | 100 | 23% | 69% |
| 5 | OscaR - Hybrid | 100 | 23% | 69% |
| 6 | choco-solver *5a* | 90 | 21% | 63% |
| 7 | Concrete *3.4* | 90 | 21% | 63% |
| 8 | cosoco-sat *1.12* | 87 | 20% | 60% |
| 9 | cosoco *1.12* | 85 | 19% | 59% |
| 10 | sat4j-CSP | 60 | 14% | 42% |

# COP - sequential - CPU - 4 minutes (438 instances)

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# Mini-solver Tracks - sequential - CPU - 40 minutes

**Results for CSP (242 instances)**

| Rank | Solver | #solved | SAT/UNSAT | %inst. | %VBS |
|---|---|---|---|---|---|
| | *Virtual Best Solver (VBS)* | 190 | 122 / 68 | 79% | 100% |
| 1 | cosoco-mini *1.12* | 181 | 119/62 | 75% | 95% |
| 2 | miniBTD *2017-08-10* | 163 | 105/58 | 67% | 86% |
| 3 | Naxos *1.1.0* | 143 | 102/41 | 59% | 75% |

**Results for COP (117 instances)**

| Rank | Solver | #solved | %inst. | %VBS |
|---|---|---|---|---|
| | *Virtual Best Solver (VBS)* | 43 | 37% | 100% |
| 1 | cosoco-mini *1.12* | 42 | 36% | 98% |
| 2 | Naxos *1.1.0* | 33 | 28% | 77% |

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**Results for CSP (242 instances)**

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# Useful Data

On http://www.cril.fr/XCSP17/, many tables/diagrams and plots can be found.

Also, you can get the traces of any solver.

# Forthcoming

- Proceedings with succinct descriptions of solvers and analysis of the results.
- 2018 XCSP3 Competition, with *certainly*:
  - short table constraints (involving *)
  - the constraints `circuit` and `allDifferent-list`
  - annotations about decision variables
  - refined rules for ranking?
- MCSP3: official release in Autumn 2017 $\Rightarrow$ it is **important** to propose new series for the 2018 Competition.
- New developments of useful tools (including the website).
- XCSP3 Specifications 3.0.5, with notably smart table constraints.