

CHOCO

Chic, un Outil Contraintes avec des Objets



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A brief History

- 1999: a first CLAIRE implementation within the OCRE project, a national initiative for an open constraint solver for both teaching and research (Nantes, Montpellier, Toulouse, Bouygues, ONERA)
- 2003: a java first implementation (portability, ease of use for newcomers, etc.)
- 2008: Choco V2
a clear separation between the model and the solving machinery, complete re-factoring, a user-oriented version

An open constraint solver

- An open system
 - a source forge project
 - BSD license for all possible usages
- A glass box
 - designed for both teaching and research
 - readable yet efficient

A choco example

```
//1- Create the model
Model m = new CPMoel();
int n = 6;
//2- declaration of variables
IntegerVariable[] vars = makeIntVarArray("v", n, 0, 5, "cp:enum");
IntegerVariable obj = makeIntVar("obj",0,100,"cp:bound");

//3- add some constraints
String regexp = "(1|2)(3*)(1|4|5)";
m.addConstraint(regular(regexp, vars));
m.addConstraint(neq(vars[0], vars[5]));
m.addConstraint(eq(scalar(new int[]{2,3,1,-2,8,10}, vars), obj));

//4- Create the solver
Solver s = new CPSolver();
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Model m = new CPModel();
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//4- Create the solver
Solver s = new CPSolver();

//5- read the model and solve it
s.read(m);
s.solve();
if (s.isFeasible()) {
    do {
        for (int i = 0; i < n; i++) {
            System.out.print(s.getVar(vars[i]).getVal());
        }
        System.out.println("");
    } while (s.nextSolution());
}
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Choco features

- Variables : Integer (Bound and Enum), Set, Real, Composite (plus, minus, scalar, mult, ...)
- Constraints :
 - arithmetic : equal, less than, not equal ...
 - extentional : AC3r, GAC3rm (positive, negative), AC200I....
 - global : alldifferent (bound and ac), gcc (bound and ac), cumulative, regular, occurrence, disjunctive, lex, ...
 - exclusive : Tree, Geost, Cost regular
 - reified : or, and, not, implies...

Choco features

- Search :
 - solve, solveAll, iterate over the solutions
 - minimize or maximize
 - solve with restarts
- Heuristics : MinDomain, DomOverWDeg, Impact

```
CPSolver s = new CPSolver();  
s.read(m);  
  
s.setGeometricRestart(14, 1.5d);  
s.setFirstSolution(true);  
s.generateSearchStrategy();  
s.attachGoal(new DomOverWDegBranching(s, new IncreasingDomain()));  
s.launch();
```


Choco choices

- Event-based propagation engine (variable oriented)
- Fine grained events (instantiation, value removals, bound modification)
- A constraint propagation queue to postpone heavy constraints
- Trailing (copying and recomputation available as well)

Choco as a blackbox

- Try to use the intensional constraints of choco :
 - Alldifferent, Disjunctive (on cliques), Distance constraints ($|x - y| = z$), linear equations, tables for equality and disequalities.
- Try to decide the level of consistency (complex predicates) :
- Arc-consistency, decomposition by introducing intermediate variables, forward-checking

```
PreProcessCPSolver s = new PreProcessCPSolver();  
//CPSolver s = new CPSolver();  
s.read(model);  
s.solve();  
s.printRuntimeStatistics();
```

Conclusion

- Choco philosophy :
 - Open for Teaching and Research
 - Living community
 - User-friendly to discover CP
- <http://choco.emn.fr/>
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Slow and steady
wins the race

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