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# Getting started with SAT4J



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# Chapter 1

## Foreword

*This document is about using SAT4J. This document is currently very incomplete but will be updated as often as possible.*

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## Chapter 2

# Introduction

The aim of the SAT4J library is to provide an efficient library of SAT solvers in Java. Compared to the OpenSAT project, the SAT4J library targets first users of SAT "black boxes", willing to embed SAT technologies into their application without worrying about the details. Since we use the library for our own research, it is also possible for SAT researchers to use it as a basis for their work.

SAT4J includes our implementation in Java of Niklas Een and Niklas Sorenson's MiniSAT specification: An extensible SAT solver. Niklas Eén and Niklas Sörensson. Proceedings of the Sixth International Conference on Theory and Applications of Satisfiability Testing, LNCS 2919, pp 502-518, 2003

Whereas the overall algorithmic of the solver is respected, the design has been adapted to Java practices. Furthermore, the initial design has been extended to allow testing several heuristics and learning schemes.

## Chapter 3

# SAT4J as a standalone solver

SAT4J can be used as a standalone tool for solving SAT, CSP and pseudo-boolean problems. MAX-SAT problems can be treated as well. Its use as an embedded library will be treated in chapter 4, page 6.

### 3.1 SAT4J as a standalone SAT solver

The SAT solver uses input files using the common CNF Dimacs format.

```
java -jar org.sat4j.core.jar cnffile
```

If you want to improve the efficiency of the library, the best thing to do is to increase the amount of memory available to the JVM and to use java hotspot server compiler.

```
java -server -XmsMAXRAM -XmxMAXRAM -jar org.sat4j.core.jar cnffile
```

### 3.2 SAT4J as a standalone CSP solver

CSP capabilities are available since release 1.5 of the library.

Note that the input format was textual for release 1.5 (using the First CSP competition table format) and is now XML because of the new XML CSP format 2.0 designed for the Second CSP competition.

Note that SAT4J does not contain a real CSP solver: it translates CSP problems given in extension into SAT problems to solve them.

To solve a CSP problem in textual format using the default encoding, use

```
java -jar sat4j-csp.jar cspfile.txt
```

To solve a CSP problem in textual format using the direct encoding, use

```
java -jar sat4j-csp.jar CSP:cspfile.txt
```

To solve a CSP problem in textual format using the binary support encoding and direct encoding for n-ary clauses, use

```
java -jar sat4j-csp.jar CSP2:cspfile.txt
```

To solve a CSP problem in textual format using the generalized support encoding, use

```
java -jar sat4j-csp.jar CSP3:cspfile.txt
```

To solve a CSP problem in XML format using the binary support encoding and direct encoding for n-ary clauses, use

```
java -jar sat4j-csp.jar cspfile.xml
```

### **3.3 SAT4J as a standalone pseudo-boolean solver**

Pseudo Poolean capabilities is available since release 1.5 of the library. Note that the library is keeping up-to-date its input format with the one of the latest PB Evaluation, which can be found at <http://www.cril.univ-artois.fr/PB07/>.

To use SAT4J with a pseudo-boolean solver, use

```
java java -jar org.sat4j.pb.jar pbfile.opb
```

### **3.4 SAT4J as a standalone MAXSAT solver**

MaxSAT capability is available since release 1.6 of the library. For these problems, use

```
java java -jar sat4j-maxsat.jar file.cnf
```

Weighted Partial MAX SAT problems are supported since release 1.7 of the library. For these problems, use the MAXSAT'06 evaluation format available at <http://www.maxsat07.udl.es/> and use the following syntax :

```
java java -jar sat4j-maxsat.jar file.wcnf
```

## Chapter 4

# SAT4J as a java library

SAT4J can be embedded as a library in any Java program who needs to solve SAT problems. The complete documentation is available at <http://sat4j.org/doc.php>.

### 4.1 Embedding a SAT solver in Java code

```
public class Example {

    public static void main(String[] args) {
        ISolver solver = SolverFactory.newDefault();
        solver.setTimeout(3600); // 1 hour timeout
        Reader reader = new DimacsReader(solver);
        // CNF filename is given on the command line
        try {
            IProblem problem = reader.parseInstance(args[0]);
            if (problem.isSatisfiable()) {
                System.out.println("Satisfiable !");
                System.out.println(reader.decode(problem.model()));
            } else {
                System.out.println("Unsatisfiable !");
            }
        } catch (FileNotFoundException e) {
            // TODO Auto-generated catch block
        } catch (ParseException e) {
            // TODO Auto-generated catch block
        } catch (IOException e) {
            // TODO Auto-generated catch block
        } catch (ContradictionException e) {
            System.out.println("Unsatisfiable (trivial)!");
        } catch (TimeoutException e) {
            System.out.println("Timeout, sorry!");
        }
    }
}
```

## Chapter 5

# Building SAT4J from the source

SAT4J source code can be found on OW2 SVN at the address [http://forge.objectweb.org/plugins/scmsvn/index.php?group\\_id=228](http://forge.objectweb.org/plugins/scmsvn/index.php?group_id=228).

We provide both an ant and a Maven build file that easily allow any user to build SAT4J from source.

First checkout the source code available on HEAD (development version!) :

```
svn checkout svn://svn.forge.objectweb.org/svnroot/sat4j/maven/trunk
```

As an alternative, you can take the source code of one of the official releases, here 2.0.5 (this is the preferred solution) :

```
svn checkout svn://svn.forge.objectweb.org/svnroot/sat4j/maven/tags/2_0_5
```

To build the library for Java 1.4 and newer, just run the ant command with no argument :

```
ant
```

To build a CSP solver just type:

```
ant csp
```

To get the list of available options, just type:

```
ant -p
```

As for Maven users, they will use the classical command to install the library:

```
mvn install
```