Tutorial on SAT Solvers

Combinatorial Problem Solving (CPS)

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SAT Solvers

■ SAT solvers take as input a CNF formula F and return:

◆ $\mathtt{sat}(+$ model): if F is satisfiable
◆ $\mathtt{unsat}$:   if F is unsatisfiable

Input Format: DIMACS (I)

- First some optional lines: `c <comment>`

- Then a line: `p cnf <num_vars> <num_clauses>`

- Then clauses:

  - Each variable is represented with an integer ≥ 1
  - Negated literals are negative integers
  - Literals in a clause separated by blank spaces
  - 0 marks the end of a clause

Input Format: DIMACS (II)

- $(x_1 \lor x_2) \land \neg x_3$

```
c This is an example of SAT formula
p cnf 3 2
1  2 0
-3 0
```

- $(x_1 \lor x_2) \land (x_1 \lor \neg x_2) \land (\neg x_1 \lor x_2) \land (\neg x_1 \lor \neg x_2)$

```
c This is an example of UNSAT formula
p cnf 2 4
 1  2 0
 1 -2 0
-1  2 0
-1 -2 0
```

Output Format

- 1st line is one of:

  - ◆ `s SATISFIABLE`

  - ◆ `s UNSATISFIABLE`

- If satisfiable, then comes a list of true literals.
  Each following line is of the form `v <list of lits>`

  Example: output for formula $(x_1 \lor x_2) \land \neg x_3$

  ```
  s SATISFIABLE
  v 1 2 -3 0
  ```

  Interpretation I with $I(x_1) = I(x_2) = 1, I(x_3) = 0$ is model