SAT Solvers

- SAT solvers take as input a CNF formula $F$ and return:
  - sat(+ model): if $F$ is satisfiable
  - unsat: if $F$ is unsatisfiable

- We will be using lingeling (developed by Armin Biere)
- Usage: lingeling [ <option> ... ] <input>
- Some options:
  - -s <seed>: set random seed
  - -o <output>: set output file
  - -h: help, shows all options
Input Format: DIMACS (I)

- First some optional comment lines: `c<comment>`
- Then a line: `p cnf <num_vars> <num_clauses>`
- Then clauses:
  - Each variable is represented with an integer $\geq 1$
  - 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

- There may be comment lines started with c that should be ignored (as in the input format)
- 1st line of the remaining lines 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 \((x_1 \lor x_2) \land \neg x_3\)

\[
\begin{align*}
\text{s SATISFIABLE} \\
v1 2 -3 0
\end{align*}
\]

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