SATISFIABILITY SOLVERS

Why satisfiability matters

- Reasoning
- Constraint satisfaction
- NP-complete problems

Satisfiability solvers

- **Systematic solvers**
  - Backtracking search
  - Sound and complete
  - E.g.: Davis-Putnam, DPLL
- **Stochastic solvers**
  - Random-restart, hill-climbing search
  - Sound but not complete
  - E.g.: GSAT, WALKSAT

Systematic solvers: DPLL

- Depth-first search
- Basic step: Pick a literal, set to true and simplify
- Backtrack if empty clause reached
- Two heuristics:
  - Unit clauses
  - Pure literals

Fig. 14 from (Weld, 1999)

Stochastic solvers: GSAT

- Hill-climbing with multiple restarts
- Initialize all variables to random values
- Basic step: Pick a variable and flip it
- Heuristic: Maximize # satisfied clauses
- Always makes move, even if downhill
- Repeat, restart after max flips

Fig. 15 from (Weld, 1999)

Stochastic solvers: WALKSAT

- Augment GSAT with simulated annealing:
  - With probability p choose same variable as GSAT
  - Else select random variable from unsatisfied clause