Proof Complexity and Solving LAB

Unit Propagation with Watched Literals

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https://github.com/JoshuaBlinkhorn/SAT-LAB

Goals

- Implemenatation of SAT solving algorithms
  (a) 2-SAT (polynomial time)
  (b) DPLL
  (c) CDCL
    - watched literals
    - clause learning
    - decision heuristics
    - restart strategy
  (d) QBF expansion..

- Practical programming experience
  - use your favourite language (Python, C, C++, Java, ..)
  - recommended: Python

Assignment Data Structure (An Apology)

- good scenario for storing the assignment:
  - store assignments in fixed location (fast access)
  - maintain a list of 'pointers' to them (the trail)
- decision level data can be stored in either

Watched Literals

- when searching for conflict, we only care about unit clauses
- a clause becomes unit when:
  - it has exactly one unassigned literal, and
  - all other literals are falsified
- sufficient to watch just two literals in every clause
- maintain this invariant for each clause:
  - either both watched literals are unassigned
  - or at least one watched literal is satisfied
- important: if both watched literals are assigned, and one is falsifed: its decision level should be no lower than the satisfied one

How is it done?

- many options - here's one:

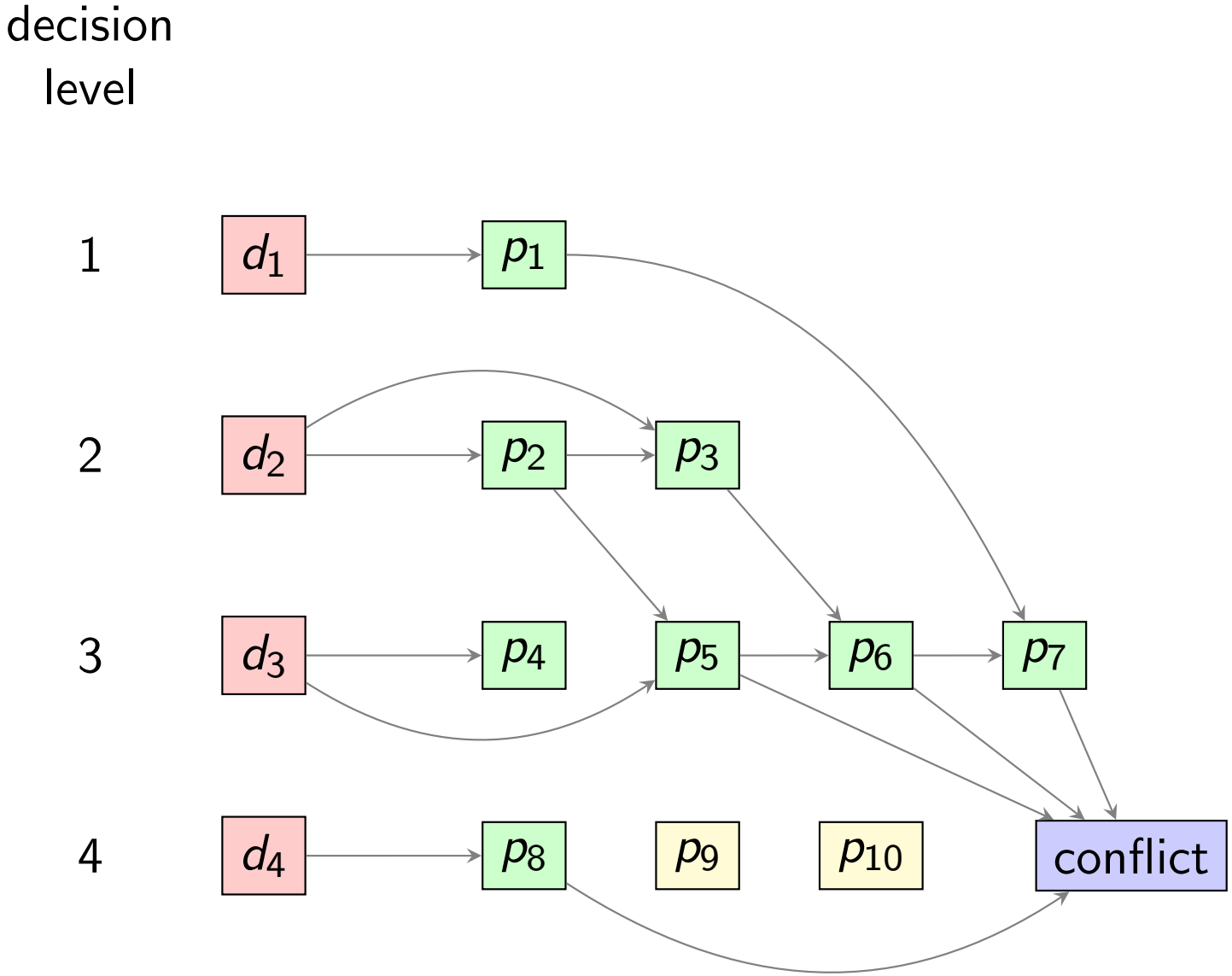
(a) maintain a list of 'watched clauses' for each literal

(b) process a variable assignment by:

1. visit watched clauses in order
2. make sure the invariant holds
   - you may need to 'swap the watch'
3. if clause becomes unit, add unit assignment to trail
   - note: in this case, both watched literals have the same decision level
   - so there is no need to swap the watch

(c) if the invariant cannot be maintained, we reach conflict

Conflicts and Backtracking



Watched Literals Task

- implement unit propagation with watched literals in your CDCL solver
- check correctness
- compare the solving time to naive propagation