



The Technology

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- Language: propositional variables can be true (1) or false (0)
- Connectives: \Rightarrow implication, \neg negation, \vee disjunction, \wedge conjunction
- Clause: disjunction of variables or their negations (literal)
- Validity: a formula is valid iff it is true for all possible assignments
- Assignment: setting all propositional variables 1 or 0, can also be expressed by showing the true literals
- we write $M \models C$ if the clause C is true by assignment M
- SAT: propositional satisfiability, find an assignment such that for a set of clauses all clauses are valid in the assignment



UProp(N, M)

while (there is a clause $C' \vee L \in N$ such that

$M \models \neg C'$ and $L \notin M$ and $\neg L \notin M$)

$M := M \cup \{L\};$

return M ;

UProp($\{\neg A \vee \neg B \vee E, \neg A \vee B, \neg E, D, A\}, \emptyset$)

$\rightarrow M = \emptyset$

$\rightarrow M = \{\neg E\}$

$\rightarrow M = \{\neg E, D\}$

$\rightarrow M = \{\neg E, D, A\}$

$\rightarrow M = \{\neg E, D, A, B\}$

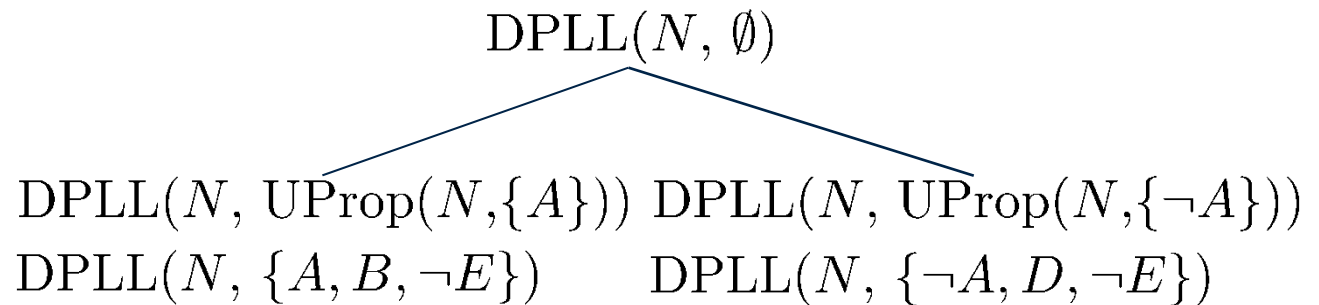


DPLL Procedure

DPLL(N, M)

if for all $C \in N$ we have $M \models C$ return true;
if there is some $C \in N$ with $M \models \neg C$ return false;
select a variable P occurring in N but not in M ;
if (DPLL($N, \text{UProp}(N, M \cup \{P\})$)) then
 return true;
else
 return DPLL($N, \text{UProp}(N, M \cup \{\neg P\})$);

$\neg A \vee \neg B \vee E$
 $\neg A \vee B$
 $\neg E$
 $A \vee D$



DPLL is sound and complete and terminating for SAT.



$XK120 \Rightarrow Model \wedge Engines$

$OTS \Rightarrow Model$

$FHC \Rightarrow Model$

$DHC \Rightarrow Model$

$Model \Rightarrow OTS \oplus FHC \oplus DHC$

$3.4I8C \Rightarrow Engines$

$3.4I9C \Rightarrow Engines$

$3.4I9CW \Rightarrow Engines$

$3.4I9CW \Rightarrow Race$

$Race \Rightarrow OTS \wedge Sports$

Reasoning: $XK120 \rightarrow Model, Engines$

$FHC \rightarrow \neg OTS, \neg DHC, \neg 3.4I9CW$



Challenge: Scalability

- worst case SAT searches 2^n nodes
- before 2009: approx. 1500 nodes
- in 2012: v.control + SPASS-SATT approx. 6000 nodes
- in x years: for a reasonable product approx. 60000 nodes



- Automated Reasoning Lecture:
<http://www.mpi-inf.mpg.de/departments/rg1/teaching/>
- contact us on student assistant jobs, bachelor-master-PhD thesis

Thank you for your attention

