

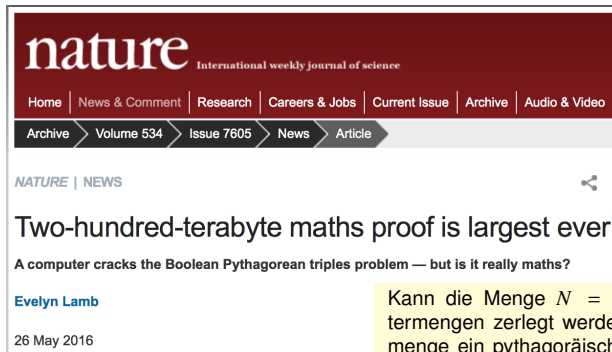
Davis-Putnam-Logemann-Loveland (DPLL) Algorithmus

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NATURE | NEWS

Two-hundred-terabyte maths proof is largest ever

A computer cracks the Boolean Pythagorean triples problem — but is it really maths?

Evelyn Lamb

26 May 2016

Beitrag von
M. Heule
O. Kullmann
V. Marek

Shown by SAT-Solver:

For $n \geq 7825$ consistent bi-coloring becomes impossible.

Kann die Menge $N = \{1, 2, \dots, n\}$ in zwei Untermengen zerlegt werden, so dass keine Untermenge ein pythagoräisches Triple (a, b, c) enthält mit $a^2 + b^2 = c^2$?

$n = 40$

$$3^2 + 4^2 = 5^2$$

$$5^2 + 12^2 = 13^2$$

$$8^2 + 15^2 = 17^2$$

$$7^2 + 24^2 = 25^2$$

$$20^2 + 21^2 = 29^2$$

$$12^2 + 35^2 = 37^2$$

(wähle die Farbe der anderen Zahlen beliebig)

Übergeordnetes Thema: Erfüllbarkeitsproblem (SAT) der Aussagenlogik

- ▶ **P vs. NP** (1 Million Dollar Frage, Clay Mathematics Institute)
- ▶ **SAT** ist **NP-vollständig**
- ▶ **SAT-Solver** trotzdem sehr erfolgreich in der Praxis

Fokus der Vorlesung: DPLL-Algorithmus

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- ▶ Literatur
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 - ▶ Martin Davis, George Logemann, Donald W. Loveland. **A Machine Program for Theorem Proving**. Commun. ACM 5(7):394-397 (1962)
 - ▶ ...
 - ▶ Robert Nieuwenhuis, Albert Oliveras, Cesare Tinelli. **Solving SAT and SAT Modulo Theories: From an abstract Davis-Putnam-Logemann-Loveland procedure to DPLL(T)**. J. ACM 53(6): 937-977 (2006)
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Syntax Aussagenlogik

$$s, t ::= \top \mid \perp \mid A \mid \neg s \mid s \vee t \mid s \wedge t \mid s \rightarrow t \mid s \leftrightarrow t$$

Semantik Aussagenlogik: Abbildung nach T (rue) oder F (alse)

s	t	$\top$	$\perp$	$\neg s$	$s \vee t$	$s \wedge t$	$s \rightarrow t$	$s \leftrightarrow t$
T	T	T	F	F	T	T	T	T
T	F	T	F	F	T	F	F	F
F	T	T	F	T	T	F	T	F
F	F	T	F	T	F	F	T	T

Klauselnormalform bzw. Konjunktive Normalform (CNF)

Beispielformel:

$$(A \wedge \neg B) \leftrightarrow (A \vee B)$$

Beispielformel in CNF:

$$(A \vee \neg B) \wedge (\neg A \vee \neg B) \wedge \neg B$$

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Notation: Konjunktion von Klausel, Klauseln, Literale

CNF

$$(A \vee \neg B) \wedge (\neg A \vee \neg B) \wedge \neg B$$

Notation für Klauseln

$$A\bar{B} \wedge \bar{A}\bar{B} \wedge \bar{B}$$

Notation für Klausel-Listen

$$A\bar{B}, \bar{A}\bar{B}, \bar{B}$$

Annahme (für Rest der Vorlesung)

Darstellung von Klauseln und Klausel-Listen: **Kommutativ und Assoziativ**

Belegungen $[\psi]$ am Beispiel:

 $[A\bar{B}]$ repräsentiert die **Belegung** $\{A \rightarrow \text{T}, B \rightarrow \text{F}\}$ $[\bar{B}]$ ist eine **partielle Belegung** für $A\bar{B}, \bar{A}\bar{B}, \bar{B}$ $[\psi] \models s$ ist **Notation** für: Belegung $[\psi]$ erfüllt Formel s $[\psi]$ wird dann auch als **Modell** für s bezeichnet

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	Eingabeformel	(CNF & Initialisierung)
[]	$A\bar{B}C, \bar{B}, C\bar{D}, BCD$	(Schritt 1)
	...	(Schritt 2)
	...	
	...	(Schritt n)
$[\bar{B}C]$	$A\bar{B}C, \bar{B}, C\bar{D}, BCD$	(Solved)

Kriterium für “Solved”?

$[\bar{B}C]$ $\underbrace{A\bar{B}C}_{\checkmark}, \underbrace{\bar{B}}_{\checkmark}, \underbrace{C\bar{D}}_{\checkmark}, \underbrace{BCD}_{\checkmark}$ —alle Klauseln sind erfüllt—

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$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{F}G}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{F}G}, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	(CNF & Initialisierung)
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{F}G}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{F}G}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	(CNF & Initialisierung)
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \bar{C}FG, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	(CNF & Initialisierung)
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{F}G}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{F}G}, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Solved)

Unit-Propagation-Regel:

$[\psi] \quad \phi, \varphi L \quad (\text{Unit-Propagation})$

Bedingung:

$\downarrow$

$[\psi] \models \neg\varphi$

$L \notin [\psi]$

$[\psi L] \quad \phi, \varphi L$

Verarbeite neue Belegungsinformation

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	(CNF & Initialisierung)
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \bar{C}FG, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \cancel{\bar{F}\bar{G}}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \bar{C}FG, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	(CNF & Initialisierung)
$[\]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{B}C\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{B}C\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}}FG, \cancel{\bar{C}}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}}\cancel{\bar{F}}G, \bar{D}E, \cancel{\bar{F}}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}}\cancel{\bar{G}}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}}\cancel{\bar{F}}G, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Solved)

Pure-Literal-Regel

$[\psi] \quad \phi, \varphi L \quad (\text{Pure-Literal})$

Bedingung:

↓

L nur mit einheitlicher Polarität in $\phi, \varphi L$

L undefiniert in $[\psi]$

$[\psi L] \quad \phi, \varphi L$

Verarbeite neue Belegungsinformation

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \bar{C}FG, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, \cancel{C\bar{G}F}, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	(CNF & Initialisierung)
$[\]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, \cancel{C\bar{G}F}, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, \cancel{C\bar{G}F}, \cancel{FG}, \cancel{\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, \cancel{C\bar{G}F}, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, \cancel{C\bar{G}F}, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, \cancel{C\bar{G}F}, \cancel{\bar{C}\bar{F}G}, \bar{C}FG, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, \cancel{C\bar{G}F}, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Solved)

Split-Regel:

$[\psi] \quad \phi \quad (\text{Split})$

Bedingung:

$\downarrow$

L und $\bar{L}$ kommen in ϕ vor

L undefiniert in $[\psi]$

$[\psi L_b] \quad \phi$

Verarbeite neue Belegungsinformation

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{FG}, \cancel{\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \cancel{\bar{F}\bar{G}}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{FG}, \cancel{\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \bar{C}FG, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{FG}, \cancel{\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \bar{C}FG, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{FG}, \cancel{\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \cancel{\bar{F}\bar{G}}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$\{\bar{B}\bar{D}C_bF_b\}$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$\{\bar{B}\bar{D}C_bF_bG\}$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[\]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

Backtrack Rule:

$[\psi L_b \psi'] \quad \phi, \varphi \quad (\text{Backtrack})$

Bedingung:

$\downarrow$

$[\psi L_b \psi'] \models \neg \varphi$

ψ' enthält keine mit “b” markierten Literale

$[\psi \bar{L}] \quad \phi, \varphi$

Verarbeite neue Belegungsinformation

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
[]	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
[$\bar{B}$]	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
[$\bar{B}\bar{D}$]	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
[$\bar{B}\bar{D}C_b$]	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
[$\bar{B}\bar{D}C_bF_b$]	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
[$\bar{B}\bar{D}C_bF_bG$]	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
[$\bar{B}\bar{D}C_b\bar{F}$]	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
[$\bar{B}\bar{D}C_b\bar{F}G$]	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	(CNF & Initialisierung)
$[\]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}\bar{F}G}, \bar{C}FG, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Solved)

Solved-Regel

$[\psi] \quad \phi \quad (\text{Solved})$

Bedingung: $[\psi] \models \phi$

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(CNF & Initialisierung)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Split)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
		(Solved)

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	(CNF & Initialisierung)
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{B}C\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{B}C\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}}FG, \cancel{\bar{C}}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}}\bar{F}G, \bar{D}E, \cancel{\bar{F}}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}}\cancel{\bar{G}}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}}\bar{F}G, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Solved)

Fail-Regel:

$[\psi] \quad \phi, \varphi \quad (\text{Split})$

Bedingung:

$\downarrow$

$[\psi] \models \neg\varphi$

ψ enthält keine Backtrack-Literale

$[] \quad \text{Fail}$

DPLL-Algorithmus — Entwicklung am Beispiel

	Eingabe-Formel	(CNF & Initialisierung)
$[]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Pure-Literal)
$[\bar{B}\bar{D}]$	$A\bar{B}, \bar{B}, \cancel{BC\bar{E}F}, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \bar{F}\bar{G}$	(Split)
$[\bar{B}\bar{D}C_bF_b]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \cancel{\bar{C}\bar{F}G}, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_bF_bG]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \cancel{\bar{F}\bar{G}}$	(Backtrack)
$[\bar{B}\bar{D}C_b\bar{F}]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \cancel{\bar{C}FG}, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Unit-Propagation)
$[\bar{B}\bar{D}C_b\bar{F}G]$	$A\bar{B}, \bar{B}, BC\bar{E}F, C\bar{G}F, \bar{C}FG, \bar{C}\bar{F}G, \bar{D}E, \bar{F}\bar{G}$	(Solved)

Abstrakter DPLL Algorithmus (Regelbasierte Darstellung)

Wende die Regeln erschöpfend an mit folgender Priorität:

1. Solved
2. Fail
3. Backtrack
4. Unit-Propagation
5. Pure-Literal
6. Split

Möglichkeiten zur weiteren Verbesserung bzw. Optimierung

- ▶ Heuristiken für Split: z.B. wähle das am häufigsten vorkommende Literal (Vorheriges Beispiel: wähle F zuerst – diese Wahl verhindert Backtracking und generiert eine alternative Belegung (Übungsaufgabe))
- ▶ Nicht-chronologisches Backtracking
- ▶ Klausel-Lernen beim Backtracking
- ▶ Effiziente Datenstrukturen
- ▶ Indexing-Techniken, Watchlist
- ▶ ...

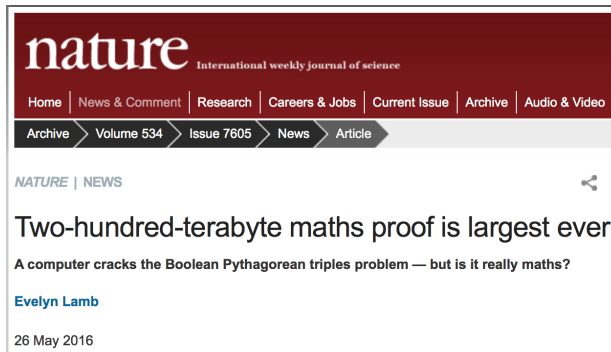
Korrektheit und Vollständigkeit: für abstraktes System in Vorlesung

Systeme (z.B. zChaff, MiniSat, PicoSat, Limmat, Lingeling)

Anwendungsbeispiele

Satisfiability modulo Theories

Beispiel einer Erfolgsgeschichte



The screenshot shows the top section of the Nature journal website. The header is dark red with the 'nature' logo in white. Below the logo is the tagline 'International weekly journal of science'. A navigation bar contains links: Home, News & Comment, Research, Careers & Jobs, Current Issue, Archive, and Audio & Video. Below this is a secondary navigation bar with links: Archive, Volume 534, Issue 7605, News (highlighted), and Article. The main content area has a light gray background. It starts with 'NATURE | NEWS' and a share icon. The article title is 'Two-hundred-terabyte maths proof is largest ever'. Below the title is a subtitle: 'A computer cracks the Boolean Pythagorean triples problem — but is it really maths?'. The author's name, 'Evelyn Lamb', is listed in blue. The date, '26 May 2016', is at the bottom.

nature
International weekly journal of science

Home | News & Comment | Research | Careers & Jobs | Current Issue | Archive | Audio & Video

Archive | Volume 534 | Issue 7605 | **News** | Article

NATURE | NEWS

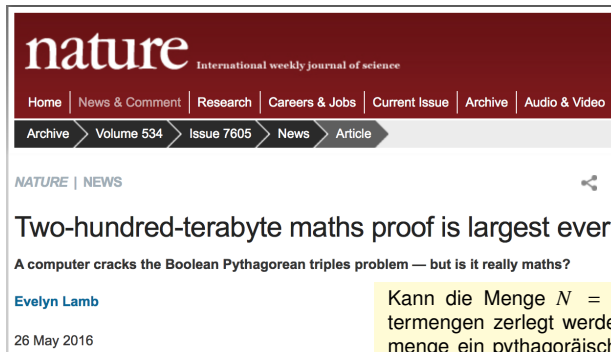
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[Evelyn Lamb](#)

26 May 2016

Beitrag von
M. Heule
O. Kullmann
V. Marek



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nature International weekly journal of science

Home | News & Comment | Research | Careers & Jobs | Current Issue | Archive | Audio & Video

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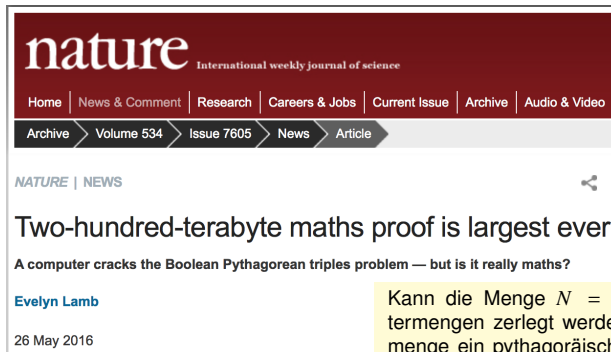
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Kann die Menge $N = \{1, 2, \dots, n\}$ in zwei Untermengen zerlegt werden, so dass keine Untermenge ein pythagoräisches Triple (a, b, c) enthält mit $a^2 + b^2 = c^2$?

$n = 10$

$$3^2 + 4^2 = 5^2$$

(wähle die Farbe der anderen Zahlen beliebig)



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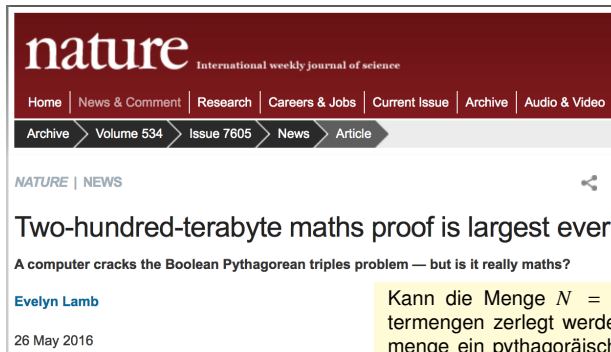
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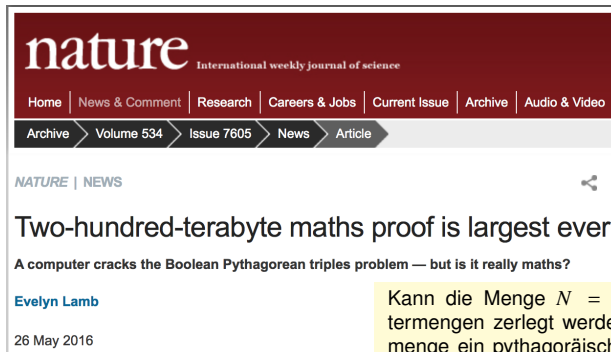
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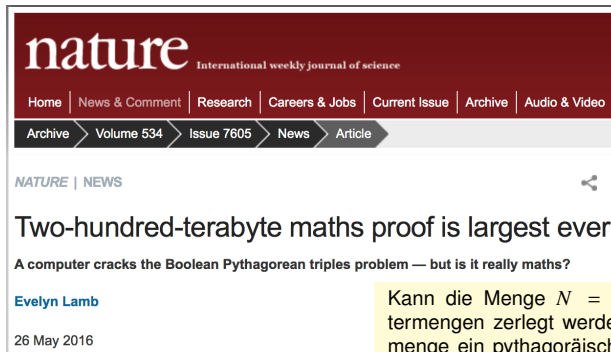
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Kann die Menge $N = \{1, 2, \dots, n\}$ in zwei Untermengen zerlegt werden, so dass keine Untermenge ein pythagoräisches Triple (a, b, c) enthält mit $a^2 + b^2 = c^2$?

$n = 10$

$$3^2 + 4^2 = 5^2$$

Verboten: nur eine Farbe!



The screenshot shows the top navigation bar of the Nature journal website. The header includes the 'nature' logo and the tagline 'International weekly journal of science'. Below this is a row of links: Home, News & Comment, Research, Careers & Jobs, Current Issue, Archive, and Audio & Video. A secondary navigation bar highlights 'Archive', 'Volume 534', 'Issue 7605', 'News', and 'Article'. The main content area displays the article title 'Two-hundred-terabyte maths proof is largest ever' by Evelyn Lamb, dated 26 May 2016. A sub-headline reads 'A computer cracks the Boolean Pythagorean triples problem — but is it really maths?'. A share icon is visible to the right of the article title.

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NATURE | NEWS

Two-hundred-terabyte maths proof is largest ever

A computer cracks the Boolean Pythagorean triples problem — but is it really maths?

Evelyn Lamb

26 May 2016

Beitrag von
M. Heule
O. Kullmann
V. Marek

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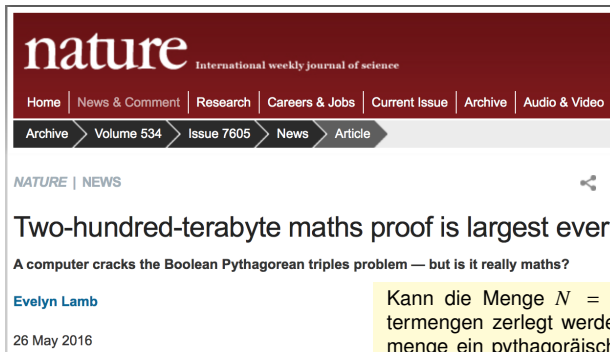
$n = 20$

$$3^2 + 4^2 = 5^2$$

$$5^2 + 12^2 = 13^2$$

$$8^2 + 15^2 = 17^2$$

(wähle die Farbe der anderen Zahlen beliebig)



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$n = 30$

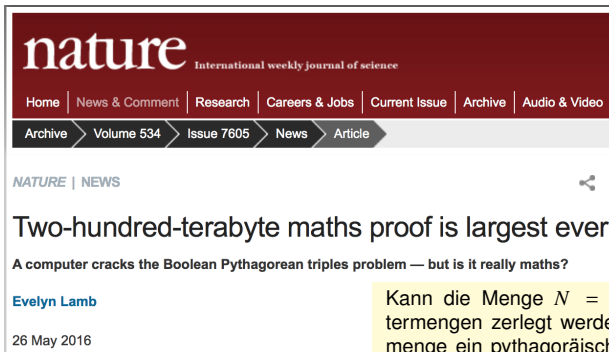
$$3^2 + 4^2 = 5^2$$

$$5^2 + 12^2 = 13^2$$

$$8^2 + 15^2 = 17^2$$

$$7^2 + 24^2 = 25^2$$

(choose color of the other numbers arbitrarily)



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$n = 40$

$$3^2 + 4^2 = 5^2$$

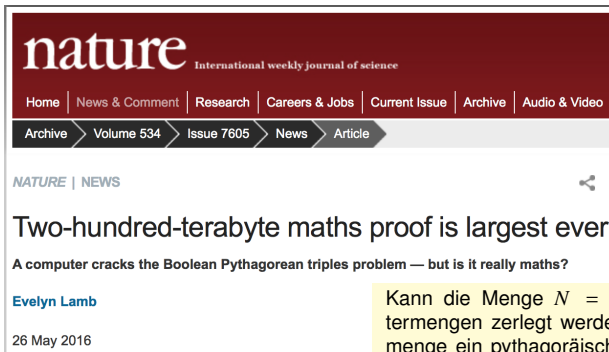
$$5^2 + \boxed{12}^2 = 13^2$$

$$8^2 + 15^2 = 17^2$$

$$7^2 + 24^2 = 25^2$$

$$20^2 + 21^2 = 29^2$$

$$\boxed{12}^2 + 35^2 = 37^2$$



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Shown by SAT-Solver:

For $n \geq 7825$ consistent bi-coloring becomes impossible.

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$$12^2 + 35^2 = 37^2$$

(wähle die Farbe der anderen Zahlen beliebig)