Satisfiability Modulo Theories

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Satisfiability Modulo Theories

Problème SMT

- Le problème SMT consiste à décider de la satisfiabilité de formules logiques contenant des symboles de théories particulières.
- Par exemple :

$$\exists x, y.(x \leq 0 \vee x + y \leq 0) \wedge y \geq 1 \wedge x \geq 1$$

(par la suite, on omettra les quantificateurs et on considérera que les variables libres de la formule sont existentiellement quantifiées)

Satisfiability Modulo Theories

Quelles formules ? Quelles contraintes ?

- En toute généralité, les solveurs SMT peuvent prendre en entrée des formules quelconques de la logique du premier ordre.
- En pratique, il y a des solveurs SMT qui prennent en entrée uniquement des formules booléennes avec une seule théorie (par ex. l'arithmétique linéaire sur les entiers).
- Mais il y a aussi des solveurs qui traitent toute la logique du premier ordre avec quantificateurs, des langages de types riches (polymorphisme, types algébriques, etc.) et des théories sur des objets complexes (par ex. ODEs)

Satisfiability Modulo Theories

Quelles théories ?

- Des théories décidables (pour lesquelles il existe un algorithme).
- Exemples de théories :
  - Égalité avec symboles non interprétés.
  - Arithmétique.
  - Tableaux.
  - Types inductifs.
  - Vecteurs de bits.
  - Certains fragments de la théorie des ensembles.

Satisfiability Modulo Theories

Combinaison de théories

- En pratique, les théories ne sont pas isolées.
- La vérification de programmes a besoin d'aritmétique, de tableaux, de vecteurs de bits, etc.
- Il y a un réel besoin de combiner les théories.
- Le problème est difficile.
- Des méthodes existent : Shostak, Nelson-Oppen.

Satisfiability Modulo Theories

Principe

- On s'interface avec un solveur SAT.
- On fait des aller-retours entre le solveur SAT et la théorie.
- La méthode du solveur peut être quelconque (DPLL par exemple).
- Mais pour optimiser, il faut modifier la méthode du solveur.
- C'est ce que nous verrons dans ce cours (méthode DPLL(T)).

Satisfiability Modulo Theories

Principe (plus précisément)

On se donne une formule Φ et on se pose la question :

Φ est-elle satisfiable ?

Pour répondre à cette question, on applique l'algorithme suivant :

1. Convertir Φ en forme CNF.
2. Remplacer chaque littéral par une variable propositionnelle.
3. Appeler un solveur SAT afin d'obtenir un modèle $\mathcal{M}$ booléen de Φ.
4. Convertir $\mathcal{M}$ en contraintes pour la théorie et le faire vérifier par la procédure de décision de la théorie.

Si $\mathcal{M}$ est satisfiable dans la théorie, alors la formule Φ l'est également, sinon on ajoute $\neg\mathcal{M}$ à Φ et on retourne en 2.

Satisfiability Modulo Theories

Exemple (informel)

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On applique l'algorithme :

- La formule est déjà en forme CNF.
- Abstraction booléenne : $(1 \vee 2) \wedge 3 \wedge 4$.
- Appel de SAT : modèle $\mathcal{M}_1 = 1\ \bar{2}\ 3\ 4$
  Mais la théorie dit que 1 et 4 sont en contradiction !
  On ajoute $\neg\mathcal{M}_1$: $(1 \vee 2) \wedge 3 \wedge 4 \wedge (\bar{1} \vee 2 \vee \bar{3} \vee \bar{4})$
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- Appel de SAT : modèle $\mathcal{M}_3 = 1\ 2\ 3\ 4$
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Inconvénient de la méthode précédente

- La recherche de modèles n'est pas guidée par la théorie.
- Pour résoudre ce problème, on va intégrer directement le raisonnement modulo théories dans la méthode de recherche de preuve SAT.
- Dans notre cas, nous allons étendre DPLL.

Extensions de DPLL

DPLL abstrait

- Ce sont les règles de DPLL classique mais où les littéraux sont des littéraux du premier ordre et non plus des variables propositionnelles.
- On prépare le terrain pour intégrer les théories.

DPLL abstrait modulo théories = DPLL(T)

- Ce sont les règles de DPLL abstrait avec des règles permettant à la théorie d'injecter de nouvelles clauses (qui sont des tautologies pour la théorie) dans l'ensemble de clauses.

DPLL abstrait

Règles

$M \parallel S, C \vee l \longrightarrow M, l \parallel S, C \vee l$	(unit prop)	si $l \notin M$ et $M \models \neg C$
$M \parallel S \longrightarrow M, l^{\mathrm{d}} \parallel S$	(decide)	si $l \notin M$, et $l \in S$ ou $\neg l \in S$
$M \parallel S, C \longrightarrow \mathrm{unsat}$	(unsat)	si $M' \models \neg C$ t.q. $M' \subseteq M$ et il n'existe pas $l^{\mathrm{d}} \leq l'$ dans M pout tout $l' \in M'$
$M, l^{\mathrm{d}}, M' \parallel S, C \longrightarrow M, l' \parallel S, C$	(backjump)	si $M, l^{\mathrm{d}}, M' \models \neg C$, et il existe une clause $C' \vee l' t.q.$: $l' \notin M$, et $l' \in S$ ou $\neg l' \in S$ ou $l' \in M, l^{\mathrm{d}}, M'$ ou $\neg l' \in M, l^{\mathrm{d}}, M'$, et $S, C \models C' \vee l'$, et $M \models \neg C'$

DPLL abstrait modulo théories = DPLL(T)

Règles

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$M \parallel S \longrightarrow M \parallel S, S'$	(learn)	$\models_T S'$, où T est une théorie

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

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unsat

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$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{1} \vee 2 \vee \bar{4} \vee 3 \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{1} \vee \bar{2} \vee \bar{3} \vee 4 \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{1} \vee 2 \vee 4 \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{1} \vee 2 \vee \bar{4} \vee 3 \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{1} \vee \bar{2} \vee \bar{3} \vee 4 \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a)=c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a)=d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{\bar{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \mathit{\bar{1}} \vee \mathit{\bar{2}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathit{1}} \vee \mathit{2} \vee \bar{\mathit{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{\mathit{1}} \vee \bar{\mathit{2}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathit{1}} \vee \mathit{2} \vee \bar{\mathit{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{\mathit{1}} \vee \bar{\mathit{2}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathit{\bar{1} \vee 2 \vee 4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathit{\bar{1} \vee 2 \vee \bar{4} \vee 3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{\bar{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{\bar{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{\bar{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathbf{\bar{1}} \vee \mathbf{2} \vee \mathbf{\bar{4}} \vee \mathbf{3}, \mathit{\bar{1} \vee \bar{2} \vee \bar{3} \vee 4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathit{1}} \vee \mathit{2} \vee \bar{\mathit{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{\mathit{1}} \vee \bar{\mathit{2}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{\bar{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \mathit{\bar{1}} \vee \mathit{\bar{2}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{\bar{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \mathit{\bar{1}} \vee \mathit{\bar{2}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a)=c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a)=d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{\bar{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \mathit{\bar{1}} \vee \mathit{\bar{2}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathit{\bar{1}} \vee \mathit{2} \vee \mathit{\bar{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \mathit{\bar{1}} \vee \mathit{\bar{2}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1} \vee 2 \vee 4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathit{\bar{1} \vee 2 \vee \bar{4} \vee 3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \mathit{\bar{1} \vee \bar{2} \vee \bar{3} \vee 4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a)=c}_{1} \wedge (\underbrace{f(g(a))\neq f(c)}_{\bar{2}} \vee \underbrace{g(a)=d}_{3}) \wedge (\underbrace{c\neq d}_{\bar{4}} \vee \underbrace{g(a)\neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathit{1}} \vee \mathit{2} \vee \bar{\mathit{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{\mathit{1}} \vee \bar{\mathit{2}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathit{1}} \vee \mathit{2} \vee \bar{\mathit{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{\mathit{1}} \vee \bar{\mathit{2}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1} \vee 2 \vee 4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathit{\bar{1} \vee 2 \vee \bar{4} \vee 3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \mathit{\bar{1} \vee \bar{2} \vee \bar{3} \vee 4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1} \vee 2 \vee 4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathit{\bar{1} \vee 2 \vee \bar{4} \vee 3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{1} \vee 2 \vee 4, \bar{1} \vee 2 \vee \bar{4} \vee 3 \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{1} \vee 2 \vee 4, \bar{1} \vee 2 \vee \bar{4} \vee 3 \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{1} \vee 2 \vee 4, \bar{1} \vee 2 \vee \bar{4} \vee 3, \mathit{\bar{1} \vee \bar{2} \vee \bar{3} \vee 4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathit{1}} \vee \mathit{2} \vee \bar{\mathit{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{\mathit{1}} \vee \bar{\mathit{2}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathit{1}} \vee \mathit{2} \vee \bar{\mathit{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{\mathit{1}} \vee \bar{\mathit{2}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathit{1}} \vee \mathit{2} \vee \bar{\mathit{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{\mathit{1}} \vee \bar{\mathit{2}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a)=c}_{1} \wedge (\underbrace{f(g(a))\neq f(c)}_{\bar{2}} \vee \underbrace{g(a)=d}_{3}) \wedge (\underbrace{c\neq d}_{\bar{4}} \vee \underbrace{g(a)\neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2}\vee 3, \bar{4}\vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2}\vee 3, \bar{4}\vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}}\vee \mathbf{3}, \bar{4}\vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}}\vee \mathbf{3}, \bar{\mathbf{4}}\vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}}\vee \mathbf{3}, \bar{\mathbf{4}}\vee \bar{\mathbf{3}}, \mathit{\bar{1}}\vee \mathit{2}\vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}}\vee \mathbf{3}, \bar{4}\vee \bar{3}, \bar{\mathbf{1}}\vee \mathbf{2}\vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}}\vee \mathbf{3}, \bar{\mathbf{4}}\vee \bar{\mathbf{3}}, \bar{\mathbf{1}}\vee \mathbf{2}\vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}}\vee \mathbf{3}, \bar{\mathbf{4}}\vee \bar{\mathbf{3}}, \bar{\mathbf{1}}\vee \mathbf{2}\vee \mathbf{4}, \mathit{\bar{1}}\vee \mathit{2}\vee \mathit{\bar{4}}\vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2}\vee 3, \bar{4}\vee \bar{3}, \bar{\mathbf{1}}\vee \mathbf{2}\vee \mathbf{4}, \bar{\mathbf{1}}\vee \mathbf{2}\vee \bar{\mathbf{4}}\vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}}\vee \mathbf{3}, \bar{4}\vee \bar{3}, \bar{\mathbf{1}}\vee \mathbf{2}\vee \mathbf{4}, \bar{\mathbf{1}}\vee \mathbf{2}\vee \bar{\mathbf{4}}\vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}}\vee \mathbf{3}, \bar{\mathbf{4}}\vee \bar{\mathbf{3}}, \bar{\mathbf{1}}\vee \mathbf{2}\vee \mathbf{4}, \bar{\mathbf{1}}\vee \mathbf{2}\vee \bar{\mathbf{4}}\vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel 1, \bar{2}\vee 3, \bar{4}\vee \bar{3}, \bar{1}\vee 2\vee 4, \bar{1}\vee 2\vee \bar{4}\vee 3, \mathit{\bar{1}}\vee \mathit{\bar{2}}\vee \mathit{\bar{3}}\vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a)=c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a)=d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathit{1}} \vee \mathit{2} \vee \bar{\mathit{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{\mathit{1}} \vee \bar{\mathit{2}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1} \vee 2 \vee 4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \mathit{\bar{1} \vee 2 \vee \bar{4} \vee 3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \mathit{\bar{1} \vee \bar{2} \vee \bar{3} \vee 4} \longrightarrow$ (unsat)

unsat

Un exemple

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \vee \mathit{4} \longrightarrow$ (backjump)

$1\ \bar{2}^{\mathrm{d}}\ 4 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (unit prop)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ 4\ \bar{3} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathit{1}} \vee \mathit{2} \vee \bar{\mathit{4}} \vee \mathit{3} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \mathbf{4}, \bar{\mathbf{1}} \vee \mathbf{2} \vee \bar{\mathbf{4}} \vee \mathbf{3}, \bar{\mathit{1}} \vee \bar{\mathit{2}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Améliorations de DPLL(T)

Plusieurs améliorations possibles

- Minimiser les clauses apprises
- Détecter les conflits plus tôt
- Faire de la propagation avec la théorie

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)
$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{1} \vee 2 \longrightarrow$ (backjump)
$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{1} \vee \bar{3} \vee 4 \longrightarrow$ (unsat)
unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)
$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)
$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)
unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \mathbf{\bar{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \mathbf{\bar{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathbf{\bar{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathbf{\bar{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)
$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)
$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)
unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)
$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)
$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)
unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)
$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)
$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)
unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)
$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)
$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)
$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)
$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)
unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \mathbf{\bar{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \mathbf{\bar{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathbf{\bar{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \mathbf{\bar{2}} \vee \mathbf{3}, \mathbf{\bar{4}} \vee \mathbf{\bar{3}}, \mathbf{\bar{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Minimiser les clauses apprises

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}}\ \bar{4}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Détecter les conflits plus tôt

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathit{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \bar{\mathit{1}} \vee \bar{\mathit{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Détecter les conflits plus tôt

Égalité avec symboles non interprétés

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$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Détecter les conflits plus tôt

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$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Détecter les conflits plus tôt

Égalité avec symboles non interprétés

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$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

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$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{\mathbf{3}} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3 \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (learn)

$1\ 2\ 3\ \bar{4} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{\mathbf{4}} \vee \bar{\mathbf{3}}, \bar{\mathbf{1}} \vee \mathbf{2}, \mathit{\bar{1}} \vee \mathit{\bar{3}} \vee \mathit{4} \longrightarrow$ (unsat)

unsat

Détecter les conflits plus tôt

Égalité avec symboles non interprétés

$$\underbrace{g(a) = c}_{1} \wedge (\underbrace{f(g(a)) \neq f(c)}_{\bar{2}} \vee \underbrace{g(a) = d}_{3}) \wedge (\underbrace{c \neq d}_{\bar{4}} \vee \underbrace{g(a) \neq d}_{\bar{3}})$$

$\emptyset \parallel 1, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (unit prop)

$1 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3} \longrightarrow$ (decide)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3} \longrightarrow$ (learn)

$1\ \bar{2}^{\mathrm{d}} \parallel \mathbf{1}, \bar{\mathbf{2}} \vee \mathbf{3}, \bar{4} \vee \bar{3}, \mathit{\bar{1}} \vee \mathit{2} \longrightarrow$ (backjump)

$1\ 2 \parallel \mathbf{1}, \bar{2} \vee 3, \bar{4} \vee \bar{3}, \bar{\mathbf{1}} \vee \mathbf{2} \longrightarrow$ (unit prop)

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unsat

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Faire de la propagation avec la théorie

Règle

- On rajoute une règle au système de règles de DPLL(T)
- La règle est très similaire à la propagation unitaire
- La différence est que la validation sémantique se fait avec la théorie
- La règle est la suivante :

$$M \parallel S \longrightarrow M, l \parallel S \quad \text{(theory prop)} \quad \text{si } l \notin M, \text{ et } l \in S \text{ ou } \neg l \in S, \text{ et } M \models_T \neg l$$

Faire de la propagation avec la théorie

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Faire de la propagation avec la théorie

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unsat

Faire de la propagation avec la théorie

Égalité avec symboles non interprétés

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