

## Problem kpAxiom

Input formula:  $(\neg a \rightarrow (b \vee c)) \rightarrow ((\neg a \rightarrow b) \vee (\neg a \rightarrow c))$

Logic: GL

### Proved

Clauses in  $R_0$  (17) are defined at the end of the document

Implication clauses in  $X_0$  (5):

$$\lambda_0 = (\tilde{p}_0 \rightarrow \tilde{p}_1) \rightarrow \tilde{p}_2$$

$$\lambda_1 = (\tilde{p}_0 \rightarrow b) \rightarrow \tilde{p}_3$$

$$\lambda_2 = (\tilde{p}_0 \rightarrow c) \rightarrow \tilde{p}_4$$

$$\lambda_3 = (\tilde{p}_2 \rightarrow \tilde{p}_5) \rightarrow \tilde{p}_6$$

$$\lambda_4 = (a \rightarrow \perp) \rightarrow \tilde{p}_0$$

Substitution

$$\tilde{p}_0 \mapsto \neg a$$

$$\tilde{p}_1 \mapsto b \vee c$$

$$\tilde{p}_2 \mapsto \neg a \rightarrow (b \vee c)$$

$$\tilde{p}_3 \mapsto \neg a \rightarrow b$$

$$\tilde{p}_4 \mapsto \neg a \rightarrow c$$

$$\tilde{p}_5 \mapsto (\neg a \rightarrow b) \vee (\neg a \rightarrow c)$$

$$\tilde{p}_6 \mapsto (\neg a \rightarrow (b \vee c)) \rightarrow ((\neg a \rightarrow b) \vee (\neg a \rightarrow c))$$

$$\tilde{g} \mapsto \text{input formula}$$

### Start

(1)  $R_0 \vdash_c \tilde{g} ?$

No( $\emptyset$ )

New world:  $w_0$

$W$		$\lambda$ s.t. $w \not\vdash_W \lambda$
$w_0$	$\emptyset$	$\lambda_0, \lambda_1, \lambda_2, \lambda_3, \lambda_4$

Selected:  $\langle w_0, \lambda_0 = (\tilde{p}_0 \rightarrow \tilde{p}_1) \rightarrow \tilde{p}_2 \rangle$

(2)  $R_0, w_0, \tilde{p}_0 \vdash_c \tilde{p}_1 ?$

No( $\{\tilde{p}_0\}$ )

New world:  $w_1$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_1$	$\tilde{p}_0$	$\lambda_3$
$w_0$	$\emptyset$	$\lambda_3, \lambda_4$

Selected:  $\langle w_1, \lambda_3 = (\tilde{p}_2 \rightarrow \tilde{p}_5) \rightarrow \tilde{p}_6 \rangle$

(3)  $R_0, w_1, \tilde{p}_2 \vdash_c \tilde{p}_5 ?$

Yes( $\{ \tilde{p}_0, \tilde{p}_2 \}$ )

$R_0, \tilde{p}_0, \tilde{p}_2 \vdash_c \tilde{p}_5$

Learned basic clause:  $\tilde{p}_0 \rightarrow \tilde{p}_6$

$R_1 = R_0 + \text{learned basic clause}$

### Restart 1 (basic)

(4)  $R_1 \vdash_c \tilde{g} ?$

No( $\{ \tilde{p}_2 \}$ )

New world:  $w_2$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_2$	$\tilde{p}_2$	$\lambda_1, \lambda_2, \lambda_4$

Selected:  $\langle w_2, \lambda_1 = (\tilde{p}_0 \rightarrow b) \rightarrow \tilde{p}_3 \rangle$

(5)  $R_1, w_2, \tilde{p}_0 \vdash_c b ?$

No( $\{ c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6 \}$ )

New world:  $w_3$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_3$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_2$	$\tilde{p}_2$	$\lambda_2, \lambda_4$

Selected:  $\langle w_2, \lambda_2 = (\tilde{p}_0 \rightarrow c) \rightarrow \tilde{p}_4 \rangle$

(6)  $R_1, w_2, \tilde{p}_0 \vdash_c c ?$

No( $\{ b, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6 \}$ )

New world:  $w_4$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_4$	$b, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_3$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_2$	$\tilde{p}_2$	$\lambda_4$

Selected:  $\langle w_2, \lambda_4 = (a \rightarrow \perp) \rightarrow \tilde{p}_0 \rangle$

(7)  $R_1, w_2, a \vdash_c \perp ?$

No( $\{a, b, \tilde{g}, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6\}$ )

New world:  $w_5$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_5$	$a, b, \tilde{g}, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6$	$\lambda_2$
$w_4$	$b, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_3$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_2$	$\tilde{p}_2$	$\emptyset$

Selected:  $\langle w_5, \lambda_2 = (\tilde{p}_0 \rightarrow c) \rightarrow \tilde{p}_4 \rangle$

(8)  $R_1, w_5, \tilde{p}_0 \vdash_c c ?$

Yes( $\{a, \tilde{p}_0\}$ )

$R_1, a, \tilde{p}_0 \vdash_c c$

Learned basic clause:  $a \rightarrow \tilde{p}_4$

$R_2 = R_1 + \text{learned basic clause}$

## Restart 2 (basic)

(9)  $R_2 \vdash_c \tilde{g} ?$

No( $\{\tilde{p}_2\}$ )

New world:  $w_6$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_6$	$\tilde{p}_2$	$\lambda_1, \lambda_2, \lambda_4$

Selected:  $\langle w_6, \lambda_1 = (\tilde{p}_0 \rightarrow b) \rightarrow \tilde{p}_3 \rangle$

(10)  $R_2, w_6, \tilde{p}_0 \vdash_c b ?$

No( $\{c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6\}$ )

New world:  $w_7$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_7$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_6$	$\tilde{p}_2$	$\lambda_2, \lambda_4$

Selected:  $\langle w_6, \lambda_2 = (\tilde{p}_0 \rightarrow c) \rightarrow \tilde{p}_4 \rangle$

(11)  $R_2, w_6, \tilde{p}_0 \vdash_c c ?$

No( $\{ b, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6 \}$ )

New world:  $w_8$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_8$	$b, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_7$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_6$	$\tilde{p}_2$	$\lambda_4$

Selected:  $\langle w_6, \lambda_4 = (a \rightarrow \perp) \rightarrow \tilde{p}_0 \rangle$

(12)  $R_2, w_6, a \vdash_c \perp ?$

No( $\{ a, b, \tilde{g}, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6 \}$ )

New world:  $w_9$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_9$	$a, b, \tilde{g}, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_8$	$b, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_7$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6$	$\emptyset$
$w_6$	$\tilde{p}_2$	$\emptyset$

Check the obtained model mod0 (see file mod0.png)

### Semantic failure

Learned axiom:

$(a \rightarrow c) \vee (c \rightarrow a)$

New clauses after clausification (5):

$a \rightarrow \tilde{p}_8$

$c \rightarrow \tilde{p}_7$

$c \wedge \tilde{p}_8 \rightarrow a$

$a \wedge \tilde{p}_7 \rightarrow c$

$$\tilde{p}_7 \vee \tilde{p}_8$$

New implication clauses after clausifications (2):

$$\lambda_6 = (a \rightarrow c) \rightarrow \tilde{p}_7$$

$$\lambda_5 = (c \rightarrow a) \rightarrow \tilde{p}_8$$

$$R_3 = R_2 + \text{new clauses}$$

Substitution

$$\tilde{p}_0 \mapsto \neg a$$

$$\tilde{p}_1 \mapsto b \vee c$$

$$\tilde{p}_2 \mapsto \neg a \rightarrow (b \vee c)$$

$$\tilde{p}_3 \mapsto \neg a \rightarrow b$$

$$\tilde{p}_4 \mapsto \neg a \rightarrow c$$

$$\tilde{p}_5 \mapsto (\neg a \rightarrow b) \vee (\neg a \rightarrow c)$$

$$\tilde{p}_6 \mapsto (\neg a \rightarrow (b \vee c)) \rightarrow ((\neg a \rightarrow b) \vee (\neg a \rightarrow c))$$

$$\tilde{p}_7 \mapsto a \rightarrow c$$

$$\tilde{p}_8 \mapsto c \rightarrow a$$

$$\tilde{g} \mapsto \text{input formula}$$

Learned axiom with the substitution applied

$$(a \rightarrow c) \vee (c \rightarrow a)$$

### Restart 3 (semantic)

(13)  $R_3 \vdash_c \tilde{g}$  ?

No(  $\{ \tilde{p}_2, \tilde{p}_7 \}$  )

New world:  $w_{10}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{10}$	$\tilde{p}_2, \tilde{p}_7$	$\lambda_1, \lambda_2, \lambda_4, \lambda_5$

Selected:  $\langle w_{10}, \lambda_1 = (\tilde{p}_0 \rightarrow b) \rightarrow \tilde{p}_3 \rangle$

(14)  $R_3, w_{10}, \tilde{p}_0 \vdash_c b$  ?

No(  $\{ c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7 \}$  )

New world:  $w_{11}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{11}$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7$	$\emptyset$
$w_{10}$	$\tilde{p}_2, \tilde{p}_7$	$\lambda_2, \lambda_4$

Selected:  $\langle w_{10}, \lambda_2 = (\tilde{p}_0 \rightarrow c) \rightarrow \tilde{p}_4 \rangle$

(15)  $R_3, w_{10}, \tilde{p}_0 \vdash_c c ?$

No( $\{b, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7\}$ )

New world:  $w_{12}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{12}$	$b, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7$	$\lambda_5$
$w_{11}$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7$	$\emptyset$
$w_{10}$	$\tilde{p}_2, \tilde{p}_7$	$\lambda_4$

Selected:  $\langle w_{12}, \lambda_5 = (c \rightarrow a) \rightarrow \tilde{p}_8 \rangle$

(16)  $R_3, w_{12}, c \vdash_c a ?$

No( $\{b, c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7\}$ )

New world:  $w_{13}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{13}$	$b, c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7$	$\emptyset$
$w_{12}$	$b, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7$	$\emptyset$
$w_{11}$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7$	$\emptyset$
$w_{10}$	$\tilde{p}_2, \tilde{p}_7$	$\lambda_4$

Selected:  $\langle w_{10}, \lambda_4 = (a \rightarrow \perp) \rightarrow \tilde{p}_0 \rangle$

(17)  $R_3, w_{10}, a \vdash_c \perp ?$

No( $\{a, b, c, \tilde{g}, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7, \tilde{p}_8\}$ )

New world:  $w_{14}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{14}$	$a, b, c, \tilde{g}, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7, \tilde{p}_8$	$\emptyset$
$w_{13}$	$b, c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7$	$\emptyset$
$w_{12}$	$b, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_3, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7$	$\emptyset$
$w_{11}$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7$	$\emptyset$
$w_{10}$	$\tilde{p}_2, \tilde{p}_7$	$\emptyset$

Check the obtained model mod1 (see file mod1.png)

### Semantic failure

Learned axiom:

$$(b \rightarrow c) \vee (c \rightarrow b)$$

New clauses after clausification (5):

$$b \rightarrow \tilde{p}_{10}$$

$$c \rightarrow \tilde{p}_9$$

$$b \wedge \tilde{p}_9 \rightarrow c$$

$$c \wedge \tilde{p}_{10} \rightarrow b$$

$$\tilde{p}_9 \vee \tilde{p}_{10}$$

New implication clauses after clausifications (2):

$$\lambda_8 = (b \rightarrow c) \rightarrow \tilde{p}_9$$

$$\lambda_7 = (c \rightarrow b) \rightarrow \tilde{p}_{10}$$

$$R_4 = R_3 + \text{new clauses}$$

Substitution

$$\tilde{p}_0 \mapsto \neg a$$

$$\tilde{p}_1 \mapsto b \vee c$$

$$\tilde{p}_2 \mapsto \neg a \rightarrow (b \vee c)$$

$$\tilde{p}_3 \mapsto \neg a \rightarrow b$$

$$\tilde{p}_4 \mapsto \neg a \rightarrow c$$

$$\tilde{p}_5 \mapsto (\neg a \rightarrow b) \vee (\neg a \rightarrow c)$$

$$\tilde{p}_6 \mapsto (\neg a \rightarrow (b \vee c)) \rightarrow ((\neg a \rightarrow b) \vee (\neg a \rightarrow c))$$

$$\tilde{p}_7 \mapsto a \rightarrow c$$

$$\tilde{p}_8 \mapsto c \rightarrow a$$

$$\tilde{p}_9 \mapsto b \rightarrow c$$

$$\tilde{p}_{10} \mapsto c \rightarrow b$$

$$\tilde{g} \mapsto \text{input formula}$$

Learned axiom with the substitution applied

$$(b \rightarrow c) \vee (c \rightarrow b)$$

### Restart 4 (semantic)

$$(18) R_4 \vdash_c \tilde{g} ?$$

$$\text{No}(\{ \tilde{p}_2, \tilde{p}_7, \tilde{p}_8, \tilde{p}_9 \})$$

New world:  $w_{15}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{15}$	$\tilde{p}_2, \tilde{p}_7, \tilde{p}_8, \tilde{p}_9$	$\lambda_1, \lambda_2, \lambda_4, \lambda_7$

Selected:  $\langle w_{15}, \lambda_1 = (\tilde{p}_0 \rightarrow b) \rightarrow \tilde{p}_3 \rangle$

(19)  $R_4, w_{15}, \tilde{p}_0 \vdash_c b ?$

Yes(  $\{ \tilde{p}_0, \tilde{p}_2, \tilde{p}_8 \}$  )

$R_4, \tilde{p}_0, \tilde{p}_2, \tilde{p}_8 \vdash_c b$

Learned basic clause:  $\tilde{p}_2 \wedge \tilde{p}_8 \rightarrow \tilde{p}_3$

$R_5 = R_4 + \text{learned basic clause}$

### Restart 5 (basic)

(20)  $R_5 \vdash_c \tilde{g} ?$

No(  $\{ \tilde{p}_2, \tilde{p}_7, \tilde{p}_9 \}$  )

New world:  $w_{16}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{16}$	$\tilde{p}_2, \tilde{p}_7, \tilde{p}_9$	$\lambda_1, \lambda_2, \lambda_4, \lambda_5, \lambda_7$

Selected:  $\langle w_{16}, \lambda_1 = (\tilde{p}_0 \rightarrow b) \rightarrow \tilde{p}_3 \rangle$

(21)  $R_5, w_{16}, \tilde{p}_0 \vdash_c b ?$

No(  $\{ c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7, \tilde{p}_9 \}$  )

New world:  $w_{17}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{17}$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7, \tilde{p}_9$	$\emptyset$
$w_{16}$	$\tilde{p}_2, \tilde{p}_7, \tilde{p}_9$	$\lambda_2, \lambda_4$

Selected:  $\langle w_{16}, \lambda_2 = (\tilde{p}_0 \rightarrow c) \rightarrow \tilde{p}_4 \rangle$

(22)  $R_5, w_{16}, \tilde{p}_0 \vdash_c c ?$

Yes(  $\{ \tilde{p}_0, \tilde{p}_2, \tilde{p}_9 \}$  )

$R_5, \tilde{p}_0, \tilde{p}_2, \tilde{p}_9 \vdash_c c$

Learned basic clause:  $\tilde{p}_2 \wedge \tilde{p}_9 \rightarrow \tilde{p}_4$

$R_6 = R_5 + \text{learned basic clause}$



**Restart 6 (basic)**

(23)  $R_6 \vdash_c \tilde{g} ?$

$\text{No}(\{ \tilde{p}_2, \tilde{p}_7, \tilde{p}_{10} \})$

New world:  $w_{18}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{18}$	$\tilde{p}_2, \tilde{p}_7, \tilde{p}_{10}$	$\lambda_1, \lambda_2, \lambda_4, \lambda_5, \lambda_8$

Selected:  $\langle w_{18}, \lambda_1 = (\tilde{p}_0 \rightarrow b) \rightarrow \tilde{p}_3 \rangle$

(24)  $R_6, w_{18}, \tilde{p}_0 \vdash_c b ?$

$\text{Yes}(\{ \tilde{p}_0, \tilde{p}_2, \tilde{p}_{10} \})$

$R_6, \tilde{p}_0, \tilde{p}_2, \tilde{p}_{10} \vdash_c b$

Learned basic clause:  $\tilde{p}_2 \wedge \tilde{p}_{10} \rightarrow \tilde{p}_3$

$R_7 = R_6 + \text{learned basic clause}$

**Restart 7 (basic)**

(25)  $R_7 \vdash_c \tilde{g} ?$

$\text{No}(\{ \tilde{p}_7, \tilde{p}_9 \})$

New world:  $w_{19}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{19}$	$\tilde{p}_7, \tilde{p}_9$	$\lambda_0, \lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_7$

Selected:  $\langle w_{19}, \lambda_0 = (\tilde{p}_0 \rightarrow \tilde{p}_1) \rightarrow \tilde{p}_2 \rangle$

(26)  $R_7, w_{19}, \tilde{p}_0 \vdash_c \tilde{p}_1 ?$

$\text{No}(\{ \tilde{g}, \tilde{p}_0, \tilde{p}_6, \tilde{p}_7, \tilde{p}_9 \})$

New world:  $w_{20}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{20}$	$\tilde{g}, \tilde{p}_0, \tilde{p}_6, \tilde{p}_7, \tilde{p}_9$	$\lambda_5, \lambda_7$
$w_{19}$	$\tilde{p}_7, \tilde{p}_9$	$\lambda_3, \lambda_4, \lambda_5, \lambda_7$

Selected:  $\langle w_{20}, \lambda_7 = (c \rightarrow b) \rightarrow \tilde{p}_{10} \rangle$

(27)  $R_7, w_{20}, c \vdash_c b ?$

$\text{No}(\{ c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7, \tilde{p}_9 \})$

New world:  $w_{21}$

$W$		$\lambda$ s.t. $w \not\models_W \lambda$
$w_{21}$	$c, \tilde{g}, \tilde{p}_0, \tilde{p}_1, \tilde{p}_2, \tilde{p}_4, \tilde{p}_5, \tilde{p}_6, \tilde{p}_7, \tilde{p}_9$	$\emptyset$
$w_{20}$	$\tilde{g}, \tilde{p}_0, \tilde{p}_6, \tilde{p}_7, \tilde{p}_9$	$\emptyset$
$w_{19}$	$\tilde{p}_7, \tilde{p}_9$	$\lambda_3, \lambda_4$

Selected:  $\langle w_{19}, \lambda_3 = (\tilde{p}_2 \rightarrow \tilde{p}_5) \rightarrow \tilde{p}_6 \rangle$

(28)  $R_7, w_{19}, \tilde{p}_2 \vdash_c \tilde{p}_5 ?$

Yes(  $\{ \tilde{p}_2 \}$  )

$R_7, \tilde{p}_2 \vdash_c \tilde{p}_5$

Learned basic clause:  $\tilde{p}_6$

$R_8 = R_7 + \text{learned basic clause}$

### Restart 8 (basic)

(29)  $R_8 \vdash_c \tilde{g} ?$

Yes( $\emptyset$ )

$R_8 \vdash_c \tilde{g}$

### Goal proved

### Problem description

Restarts: 8 (6 basic, 2 semantic)

Learned axioms (2):

$(b \rightarrow c) \vee (c \rightarrow b)$

$(a \rightarrow c) \vee (c \rightarrow a)$

Flat clauses  $R_0$  (17):

$\tilde{g} \rightarrow \tilde{p}_6$

$a \wedge \tilde{p}_0 \rightarrow \perp$

$\tilde{p}_1 \rightarrow b \vee c$

$\tilde{p}_0 \wedge \tilde{p}_2 \rightarrow \tilde{p}_1$

$\tilde{p}_3 \rightarrow \tilde{p}_5$

$\tilde{p}_0 \wedge \tilde{p}_3 \rightarrow b$

$\tilde{p}_4 \rightarrow \tilde{p}_5$

$\tilde{p}_0 \wedge \tilde{p}_4 \rightarrow c$

$\tilde{p}_5 \rightarrow \tilde{p}_3 \vee \tilde{p}_4$

$\tilde{p}_6 \rightarrow \tilde{g}$

$$\tilde{p}_2 \wedge \tilde{p}_6 \rightarrow \tilde{p}_5$$

$$b \rightarrow \tilde{p}_1$$

$$c \rightarrow \tilde{p}_1$$

$$\tilde{p}_1 \rightarrow \tilde{p}_2$$

$$b \rightarrow \tilde{p}_3$$

$$c \rightarrow \tilde{p}_4$$

$$\tilde{p}_5 \rightarrow \tilde{p}_6$$

Implication clauses  $X_0$  (5):

$$\lambda_0 = (\tilde{p}_0 \rightarrow \tilde{p}_1) \rightarrow \tilde{p}_2$$

$$\lambda_1 = (\tilde{p}_0 \rightarrow b) \rightarrow \tilde{p}_3$$

$$\lambda_2 = (\tilde{p}_0 \rightarrow c) \rightarrow \tilde{p}_4$$

$$\lambda_3 = (\tilde{p}_2 \rightarrow \tilde{p}_5) \rightarrow \tilde{p}_6$$

$$\lambda_4 = (a \rightarrow \perp) \rightarrow \tilde{p}_0$$

Clauses added in basic restarts (6):

$$\tilde{p}_0 \rightarrow \tilde{p}_6$$

$$a \rightarrow \tilde{p}_4$$

$$\tilde{p}_2 \wedge \tilde{p}_8 \rightarrow \tilde{p}_3$$

$$\tilde{p}_2 \wedge \tilde{p}_9 \rightarrow \tilde{p}_4$$

$$\tilde{p}_2 \wedge \tilde{p}_{10} \rightarrow \tilde{p}_3$$

$$\tilde{p}_6$$

Clauses added in semantic restarts (10):

$$a \rightarrow \tilde{p}_8$$

$$c \rightarrow \tilde{p}_7$$

$$c \wedge \tilde{p}_8 \rightarrow a$$

$$a \wedge \tilde{p}_7 \rightarrow c$$

$$\tilde{p}_7 \vee \tilde{p}_8$$

$$b \rightarrow \tilde{p}_{10}$$

$$c \rightarrow \tilde{p}_9$$

$$b \wedge \tilde{p}_9 \rightarrow c$$

$$c \wedge \tilde{p}_{10} \rightarrow b$$

$$\tilde{p}_9 \vee \tilde{p}_{10}$$

Implication clauses learned in semantic restarts (4):

$$\lambda_5 = (c \rightarrow a) \rightarrow \tilde{p}_8$$

$$\lambda_6 = (a \rightarrow c) \rightarrow \tilde{p}_7$$

$$\lambda_7 = (c \rightarrow b) \rightarrow \tilde{p}_{10}$$

$$\lambda_8 = (b \rightarrow c) \rightarrow \tilde{p}_9$$

Substitution

$$\tilde{p}_0 \mapsto \neg a$$

$$\tilde{p}_1 \mapsto b \vee c$$

$$\tilde{p}_2 \mapsto \neg a \rightarrow (b \vee c)$$

$$\tilde{p}_3 \mapsto \neg a \rightarrow b$$

$$\tilde{p}_4 \mapsto \neg a \rightarrow c$$

$$\tilde{p}_5 \mapsto (\neg a \rightarrow b) \vee (\neg a \rightarrow c)$$

$$\tilde{p}_6 \mapsto (\neg a \rightarrow (b \vee c)) \rightarrow ((\neg a \rightarrow b) \vee (\neg a \rightarrow c))$$

$$\tilde{p}_7 \mapsto a \rightarrow c$$

$$\tilde{p}_8 \mapsto c \rightarrow a$$

$$\tilde{p}_9 \mapsto b \rightarrow c$$

$$\tilde{p}_{10} \mapsto c \rightarrow b$$

$$\tilde{g} \mapsto \text{input formula}$$