HyperLogic®

New-Millennium Logic-based Computing & Artificial Intelligence

HyperGrader®

HyperSlate®

Hyperlog®

... is a verb: to live logically, and learn logic, anywhere anytime — and to have fun all along the way.

First-Order Logic = FOL = $\mathscr{L}_1$, Part 3

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Troy, New York 12180 USA

Intro to Logic-based AI
10/7/2024

Logic-&-AI In The News

STEVEN ROSENBUSH

AI Will Drive Broad Deflation, Silicon Valley Pioneer Vinod Khosla Says

But as the price of expertise falls toward zero, a new age of abundance can begin, Khosla says—if people let it

Artificial intelligence will be powerfully deflationary, Vinod Khosla says, unless humans interfere with its potential. (ILLUSTRATION: THOMAS R. LECHLEITER/WSJ, GETTY IMAGES)

By Steven Rosenbush + Follow

Updated Oct 02, 2024 11:21 a.m. ET

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MENLO PARK, Calif.—At a time of widespread concerns about the safety, efficacy and economics of AI, venture capital pioneer Vinod Khosla is still all in.

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MENLO PARK, Calif.—At a time of widespread concerns about the safety, efficacy and economics of AI, venture capital pioneer Vinod Khosla is still all in.

Yes, artificial intelligence will become capable of replacing a good deal of human labor, Khosla said in an interview, but that will push down the price of healthcare, education and other services. Many current forms of work will even be eliminated, but society will be able to create a more robust safety net than is possible today.

"Most expertise in the world, whether you're talking about structural engineers, oncologists, mental health therapists or primary care doctors, or journalists and teachers, that expertise will be near-free for all of us to access," Khosla said at Khosla Ventures' offices on Sand Hill Road in Silicon Valley.

Logic-&-AI In The News

STEVEN RO

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> About 80% of the work involved in 80% of jobs across the economy can be automated over time, according to Khosla. “So 64% of all jobs can be done by an AI,” he said.

Artificial intelligence will be powerfully deflationary, Vinod Khosla says, unless humans interfere with its potential. (ILLUSTRATION: THOMAS R. LECHLEITER/WSJ, GETTY IMAGES)

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In his view of the future, people’s main preoccupation may shift from earning a living to finding meaning. AI and robots would take on menial labor, leaving humans freer to explore with the support of a comprehensive social safety net.

STEVEN RO

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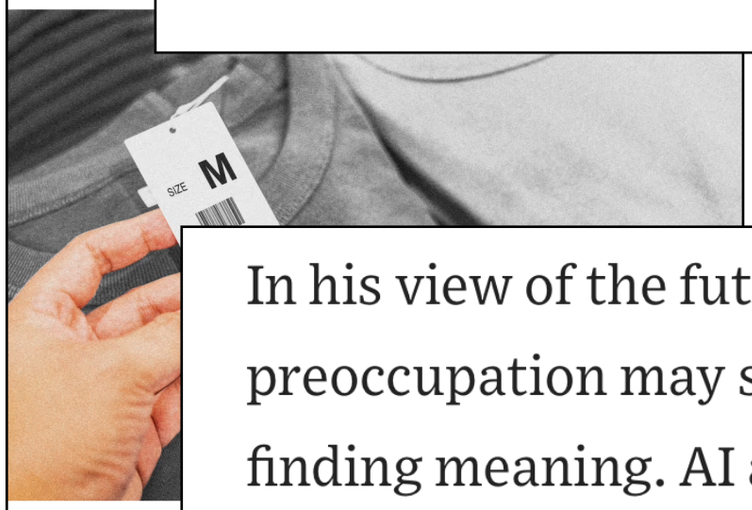

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THOMAS R. L

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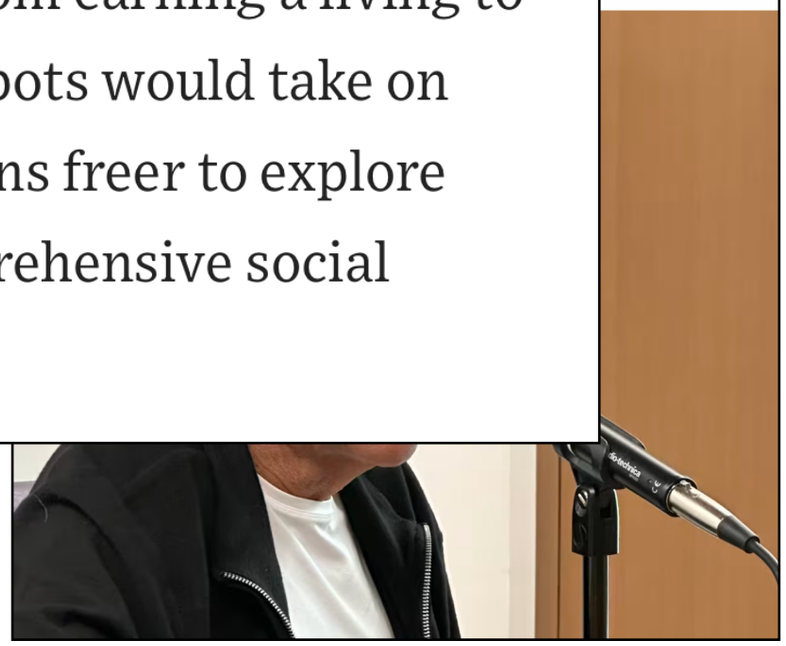

Logic-Based AI Self-Referential Tests of ChatGPT

Logic-Based AI Self-Referential Tests of ChatGPT

SE

Can you prove that if P holds, and (if P (and (Q (not Q))) holds, then the moon is made of green cheese?

No, I cannot prove that if P holds and (if P (and (Q (not Q))) holds, then the moon is made of green cheese.

The expression (Q (not Q)) is a logical contradiction, since Q cannot be both true and false at the same time. Therefore, the statement (if P (and (Q (not Q)))) is always false, regardless of the truth value of P.

Since the antecedent of the implication is always false, the implication itself is vacuously true. However, this does not provide any evidence or justification for the conclusion that the moon is made of green

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X

$$\{P, P \rightarrow (Q \wedge \neg Q)\} \vdash \bot$$

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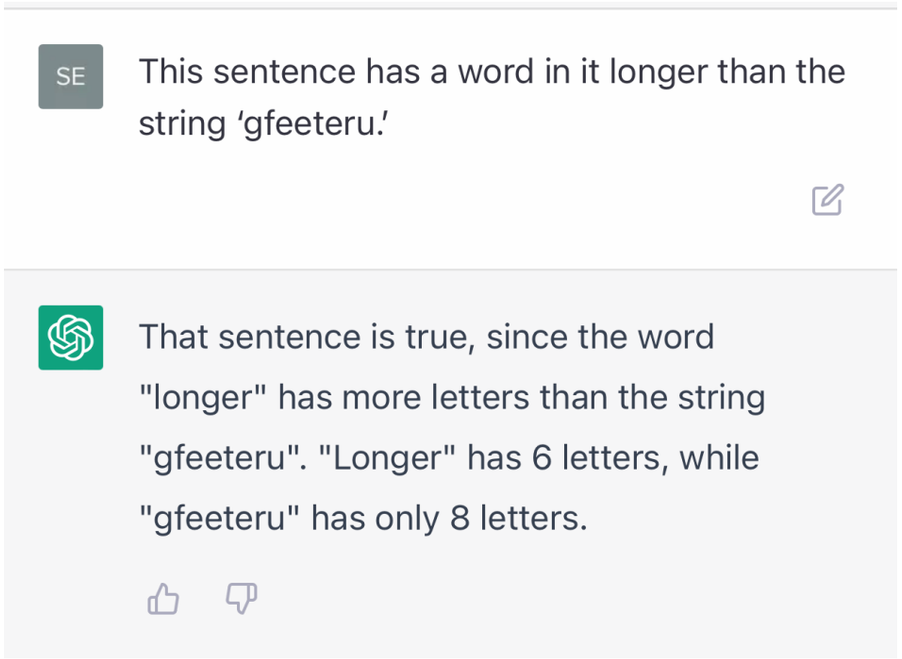

Logic-Based AI Self-Referential Tests of ChatGPT

SE

This sentence has a word in it longer than the string ‘gfeeteru.’

That sentence is true, since the word "longer" has more letters than the string "gfeeteru". "Longer" has 6 letters, while "gfeeteru" has only 8 letters.

Are you quite sure?

Logic-Based AI Self-Referential Tests of ChatGPT

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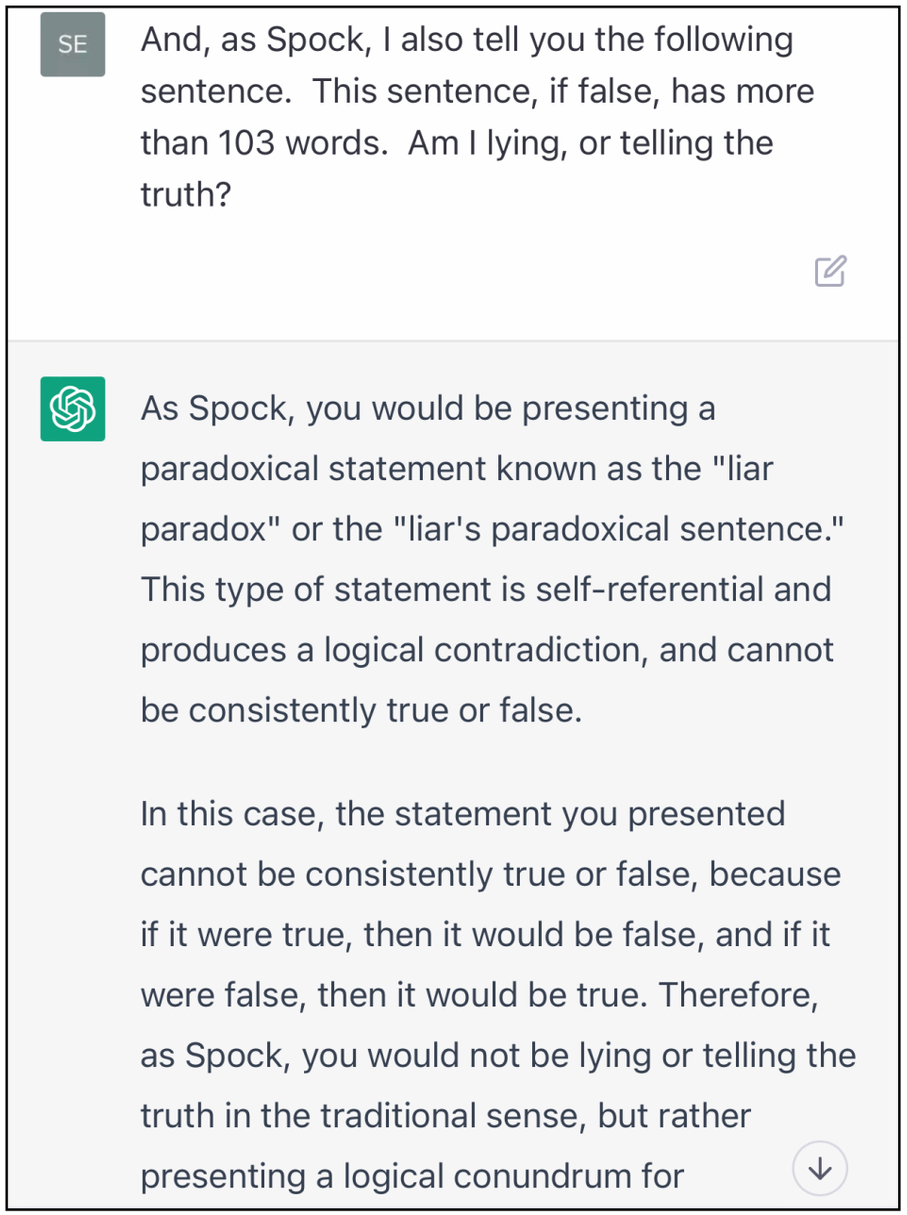


Logic-Based AI Self-Referential Tests of ChatGPT

SE

And, as Spock, I also tell you the following sentence. This sentence, if false, has more than 103 words. Am I lying, or telling the truth?

As Spock, you would be presenting a paradoxical statement known as the "liar paradox" or the "liar's paradoxical sentence." This type of statement is self-referential and produces a logical contradiction, and cannot be consistently true or false.

In this case, the statement you presented cannot be consistently true or false, because if it were true, then it would be false, and if it were false, then it would be true. Therefore, as Spock, you would not be lying or telling the truth in the traditional sense, but rather presenting a logical conundrum for

Are you quite sure?

o1 preview et al. no better …

Live-action on HyperGrader ...

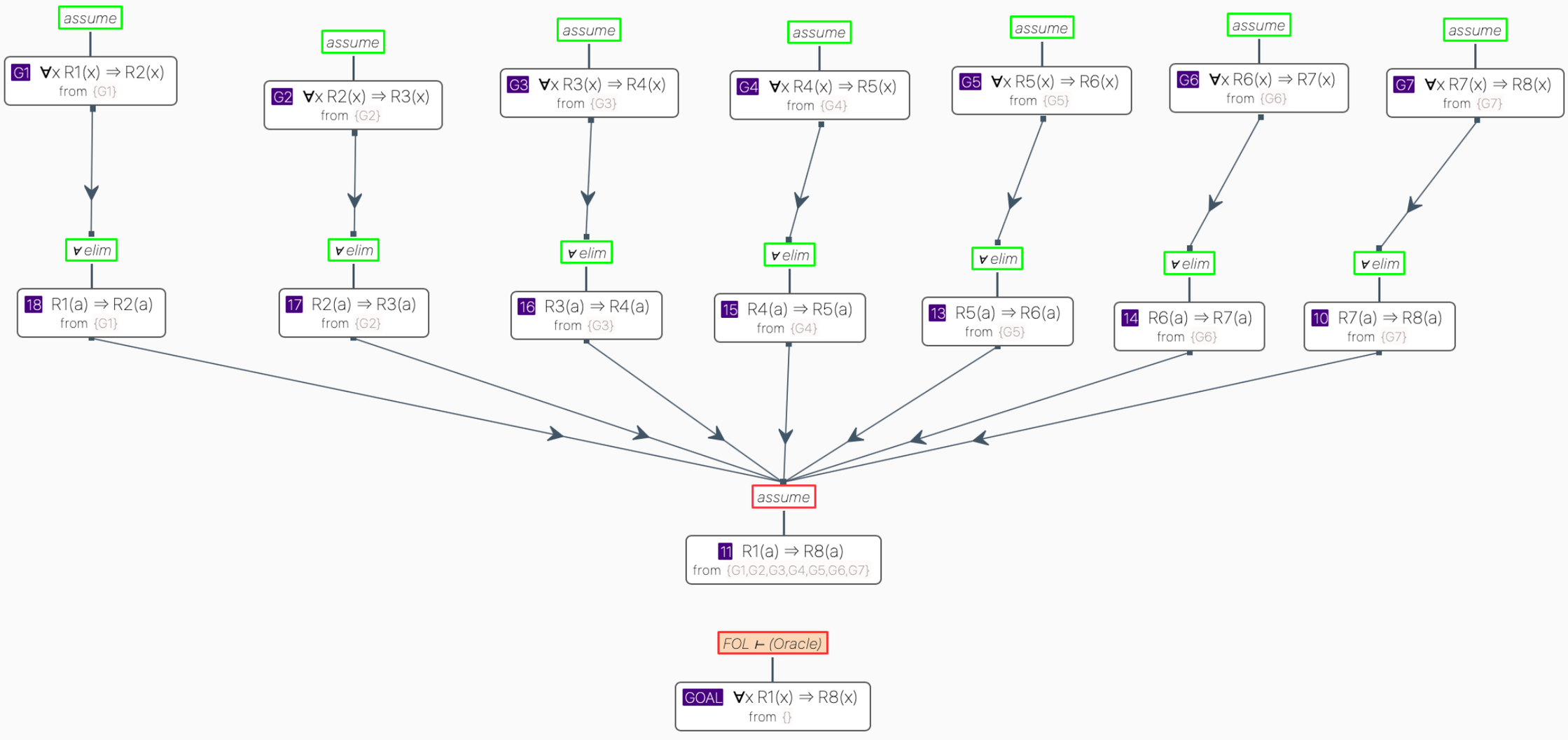
ThxForThePCOracle

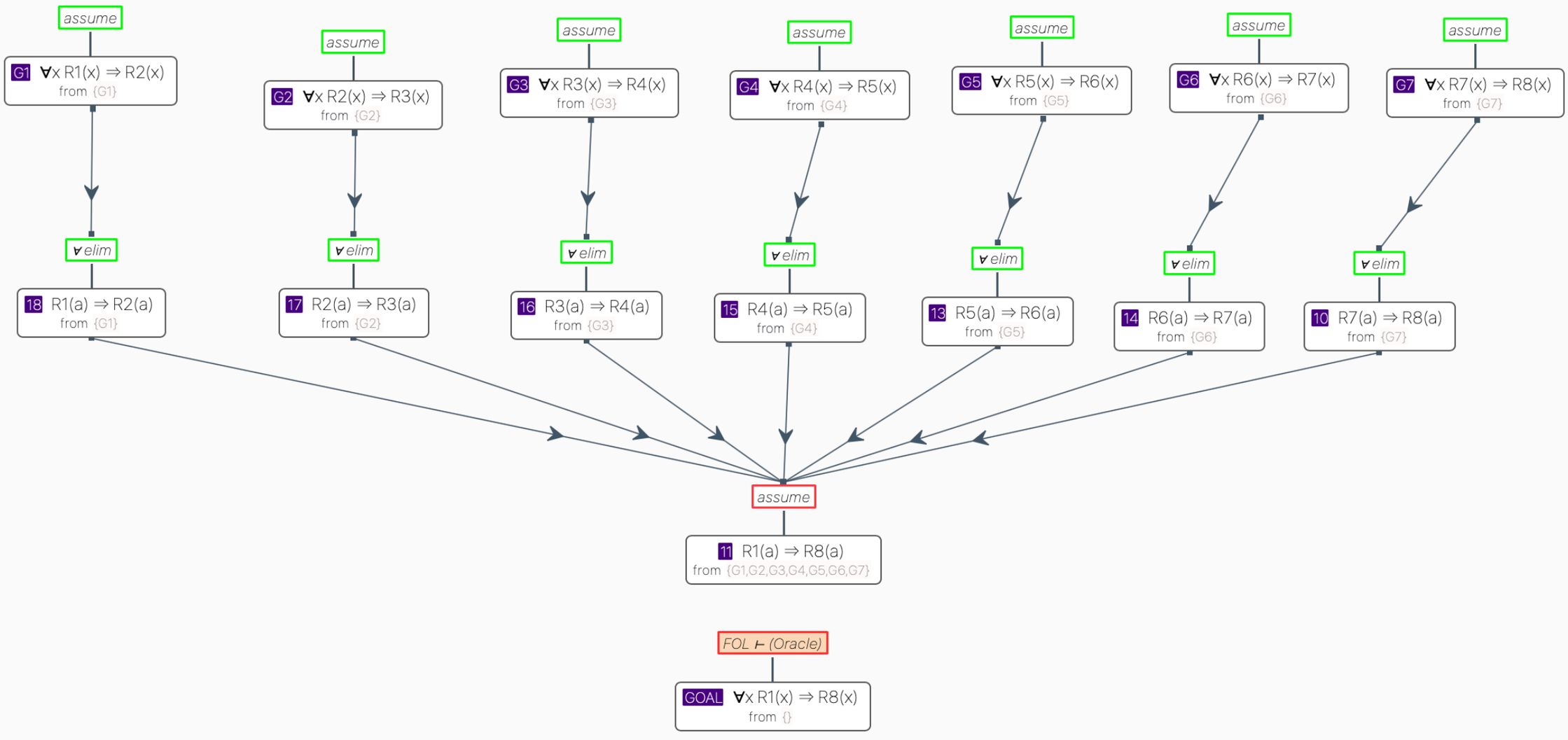
ThxForThePCOracle

Please attempt that now-ish; thx.

ThxForThePCOracle

Please attempt that now-ish; thx.





DFTII_ILBAI_Partial

DFTII_ILBAI_Partial

Please attempt that now-ish; thx.

DFTII_ILBAI_Partial

Please attempt that now-ish; thx.

DFTII_ILBAI_Partial

Please attempt that now-ish; thx.

II (1) Every yote is a pliff.
(2) No furch is a pliff.
(3) No pliff is a furch.
(4) Some furches are not pliffs.
(5) No furch is a yote.

Some furches are not yotes.

Answer: _____

For LBAI Hotshots …

For LBAI Hotshots …

Logicize Naveen's FOL zapper and see if the FOL oracle can get it!

For LBAI Hotshots …

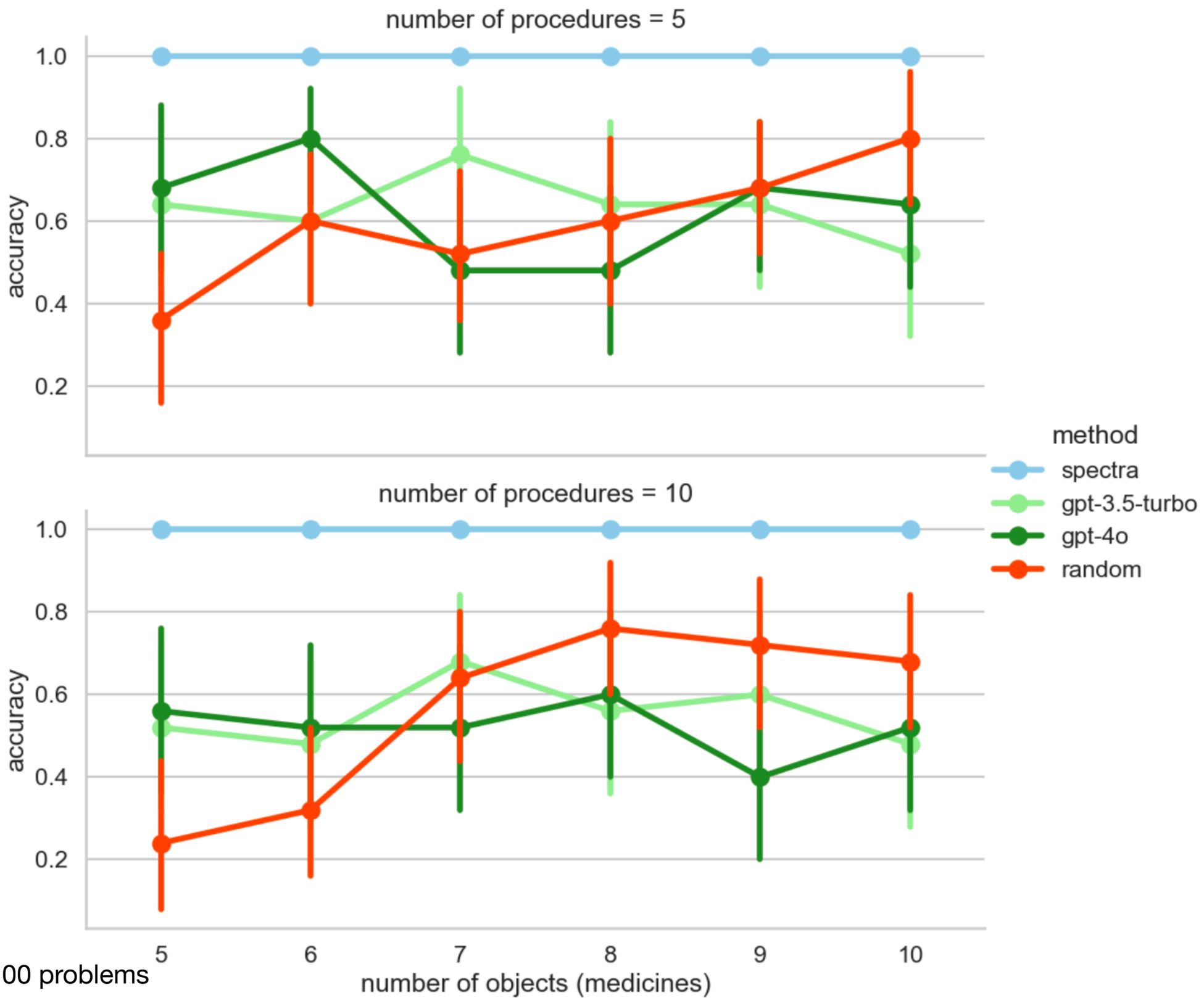
Logicize Naveen's FOL zapper and see if the FOL oracle can get it!

Example non-ToM Problem

1. synthexon is equivalent to aethersolvent.
2. rapid_hemostasis_protocol has pulmonary_reinflation_technique as its preparatory procedure.
3. rapid_hemostasis_protocol requires as input medicine aethersolvent.
4. rapid_hemostasis_protocol is an intermediate procedure.
5. pulmonary_reinflation_technique has adrenal_cortex_recovery as its preparatory procedure.
6. pulmonary_reinflation_technique requires as input medicine aethersolvent.
7. pulmonary_reinflation_technique is an intermediate procedure.
8. adrenal_cortex_recovery requires as input medicine synthexon.
9. adrenal_cortex_recovery is an inital procedure.
10. An initial procedure only requires only its input medicine to be carried out.
11. An intermediate procedure requires both its input medicine and its preparatory procedure to be carried out.

Can pulmonary_reinflation_technique be carried out?

Results without Agents



Each point represents 100 problems

Back to FOL …

Our Final New Inference Rule in FOL

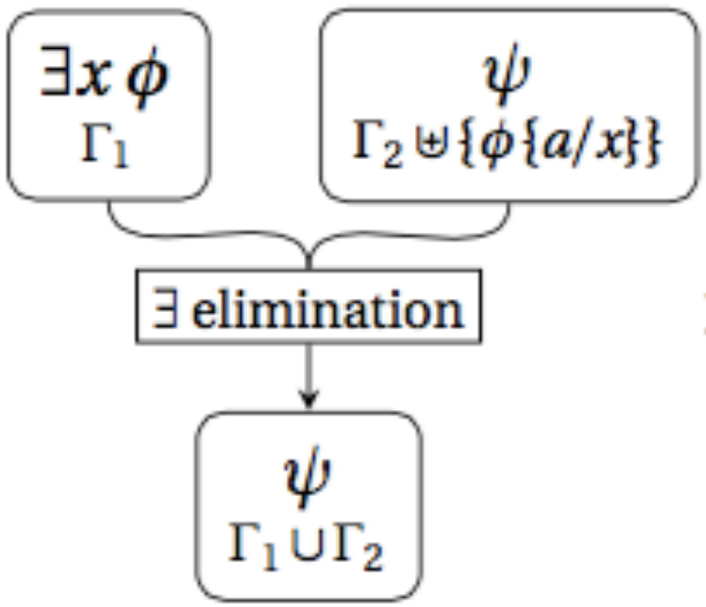
Our Final New Inference Rule in FOL

- `existential elimination` (intuitively put):

Our Final New Inference Rule in FOL

- `existential elimination` (intuitively put):
  - If we know that (i) there's something *x* which is an *R*, and (ii) on the supposition that *a* is an arbitrary representative (a "witness") of such an *x* we can prove *P*, then we are permitted to deduce *P* from (i) alone.

existential elimination, precise version:



provided that a does not appear free in Γ_1, Γ_2, or ψ

Starting State of Workspace

(Assumes a domain of e.g. players on a March-madness basketball court.)

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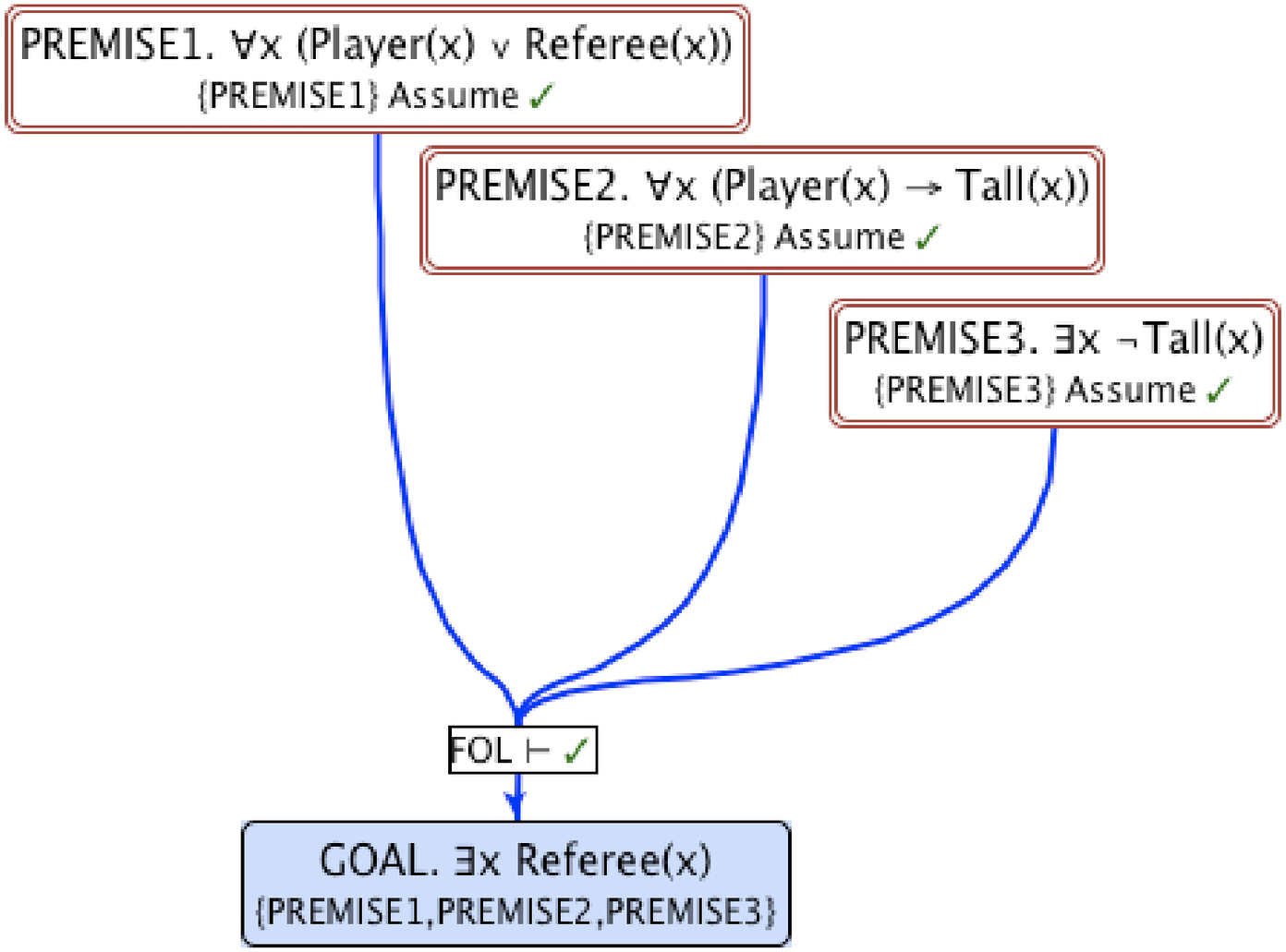
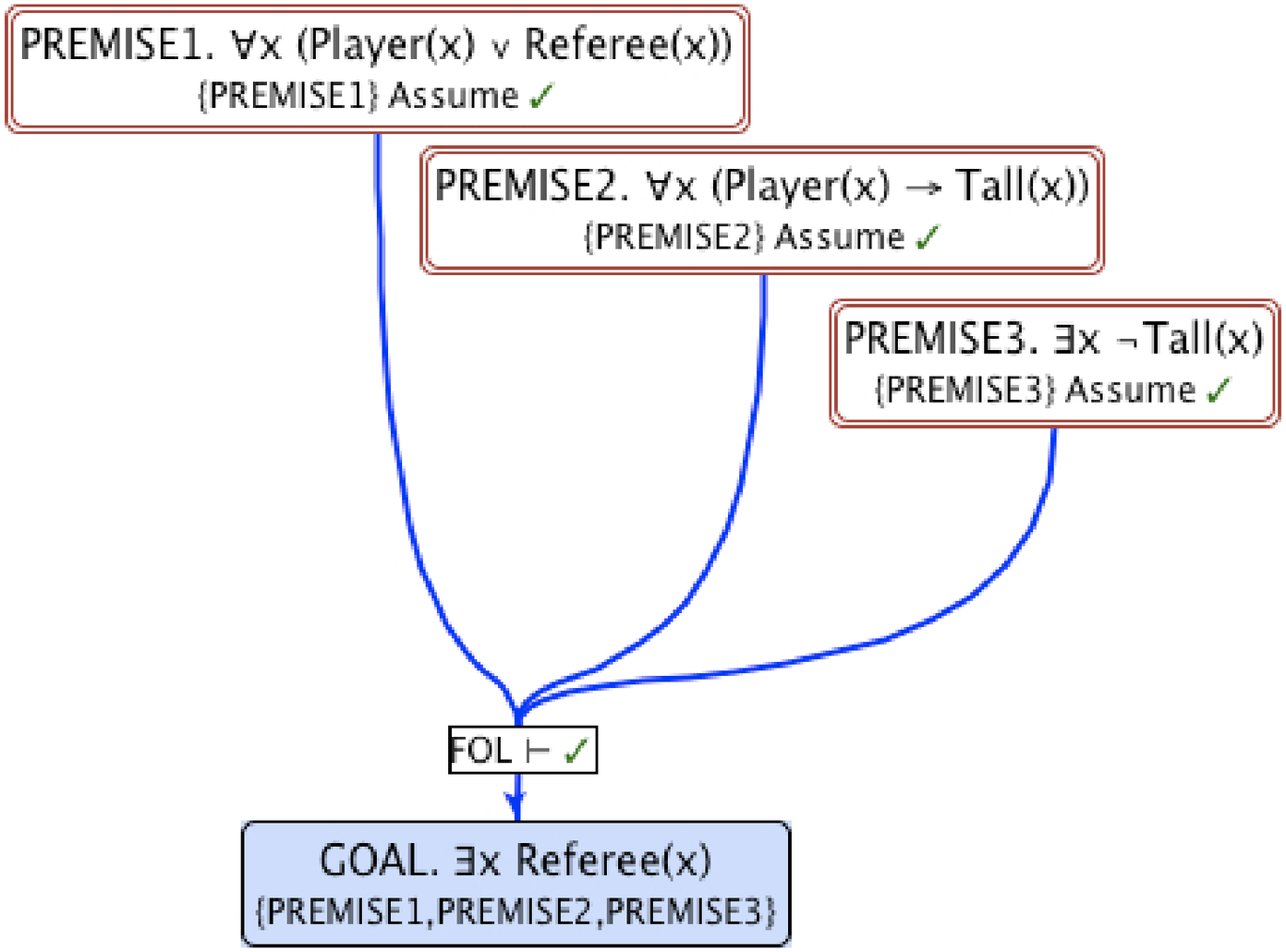


Starting State of Workspace

(Assumes a domain of e.g. players on a March-madness basketball court.)

"Each and every thing is
either a player or a referee."



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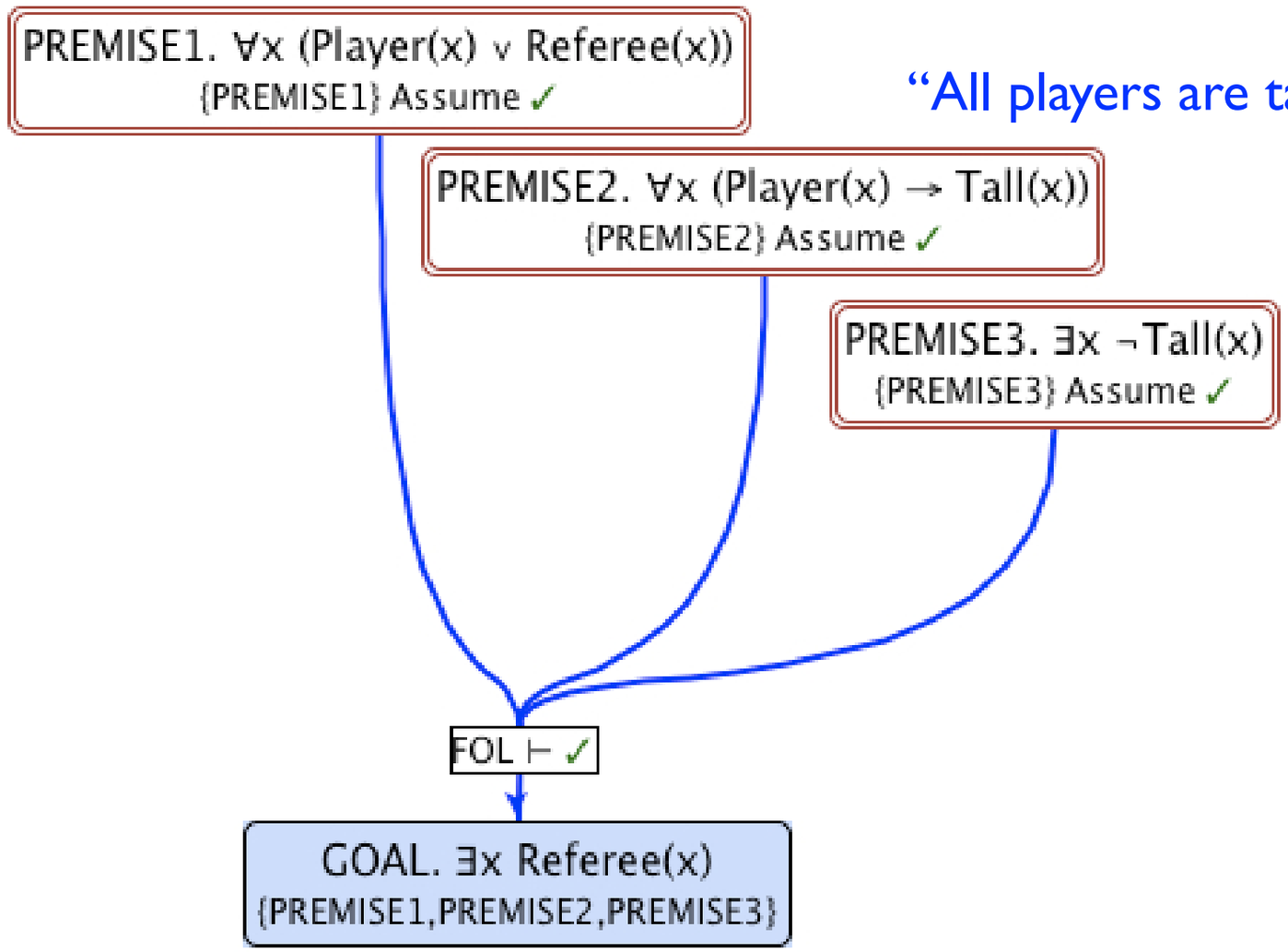

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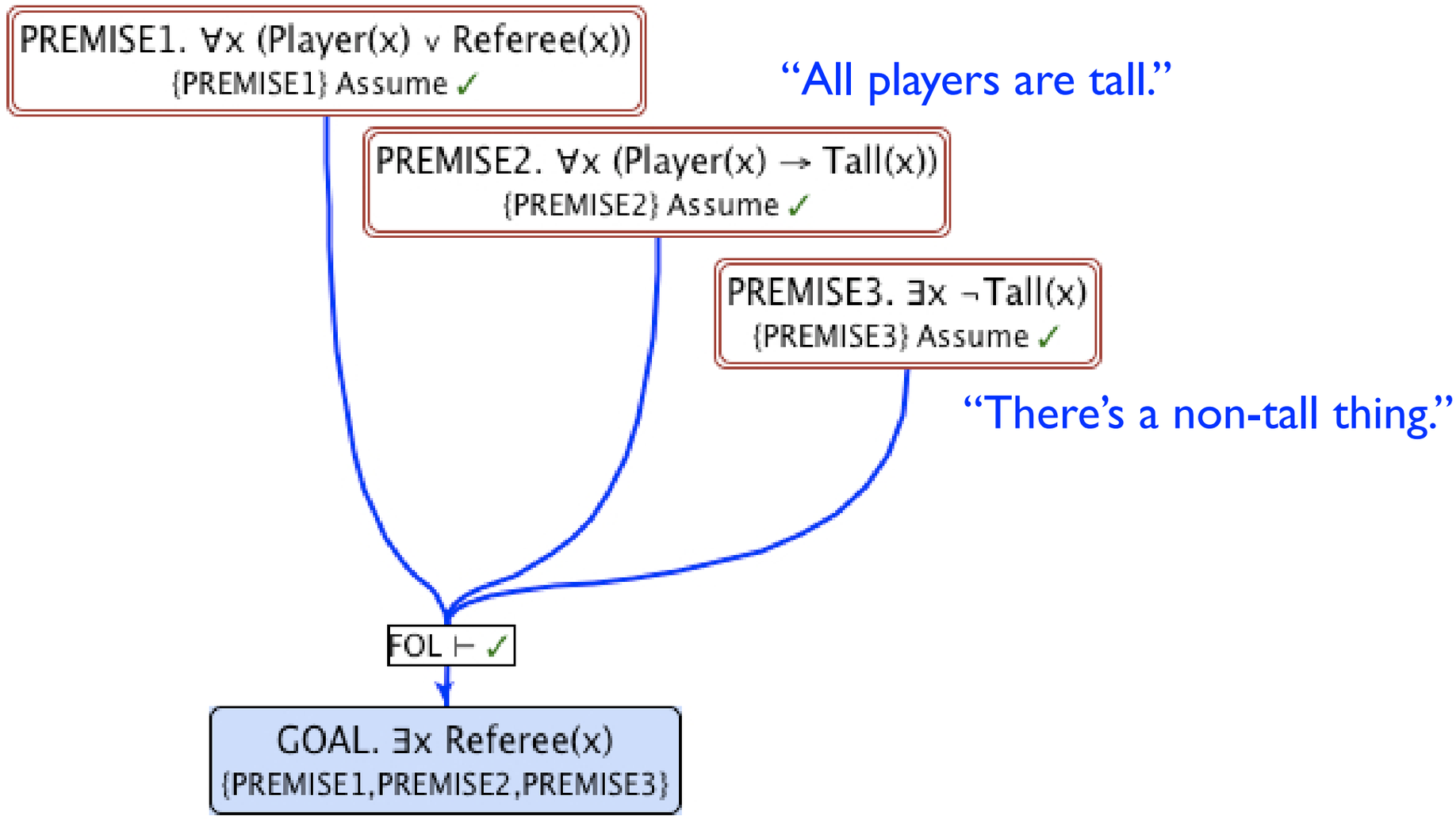


"All players are tall."

"There's a non-tall thing."

Step 1

PREMISE1. ∀x (Player(x) ∨ Referee(x))
{PREMISE1} Assume ✓

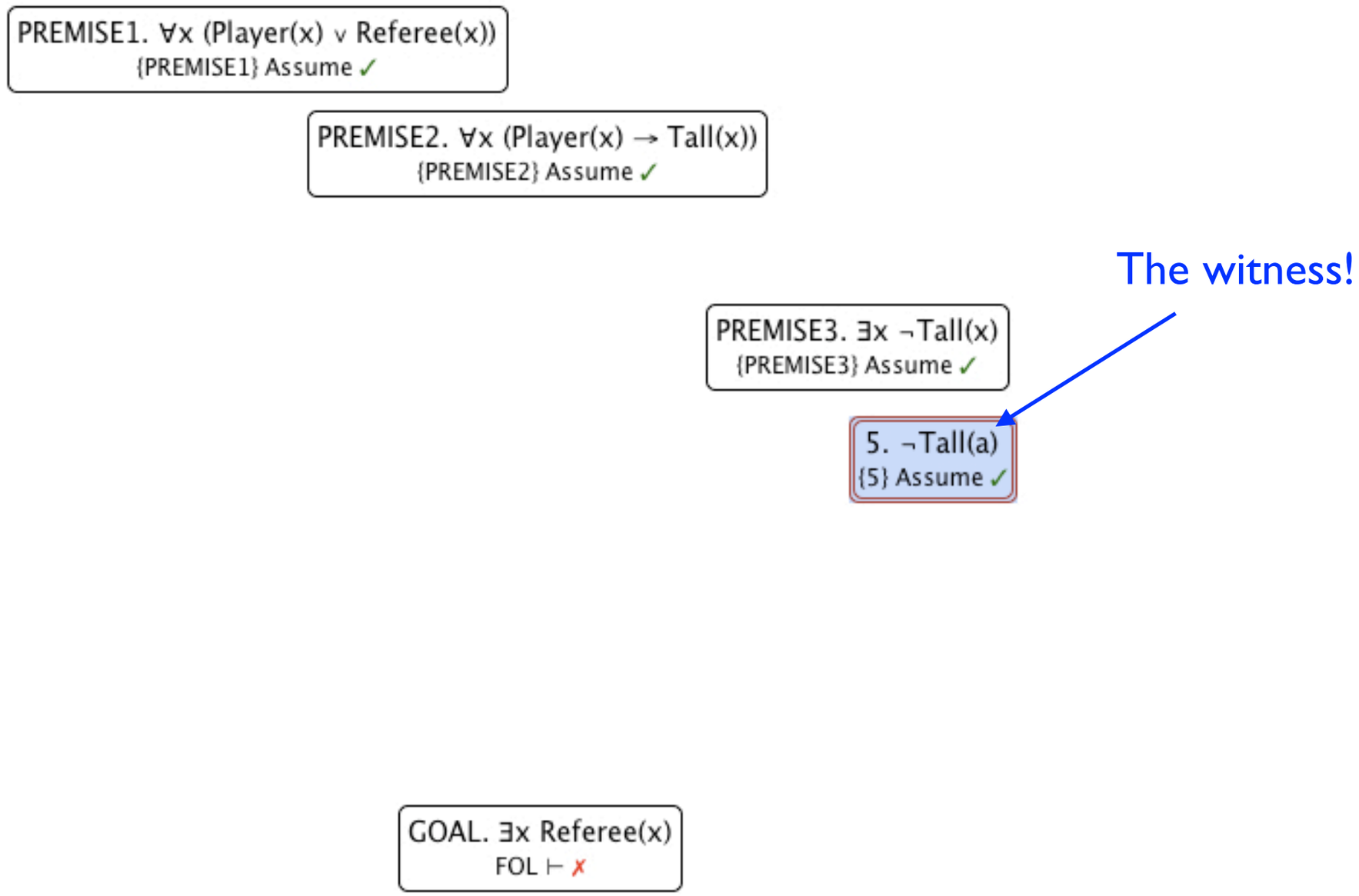
PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓

PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓

5. ¬Tall(a)
{5} Assume ✓

GOAL. ∃x Referee(x)
FOL ⊢ ✗

Step 1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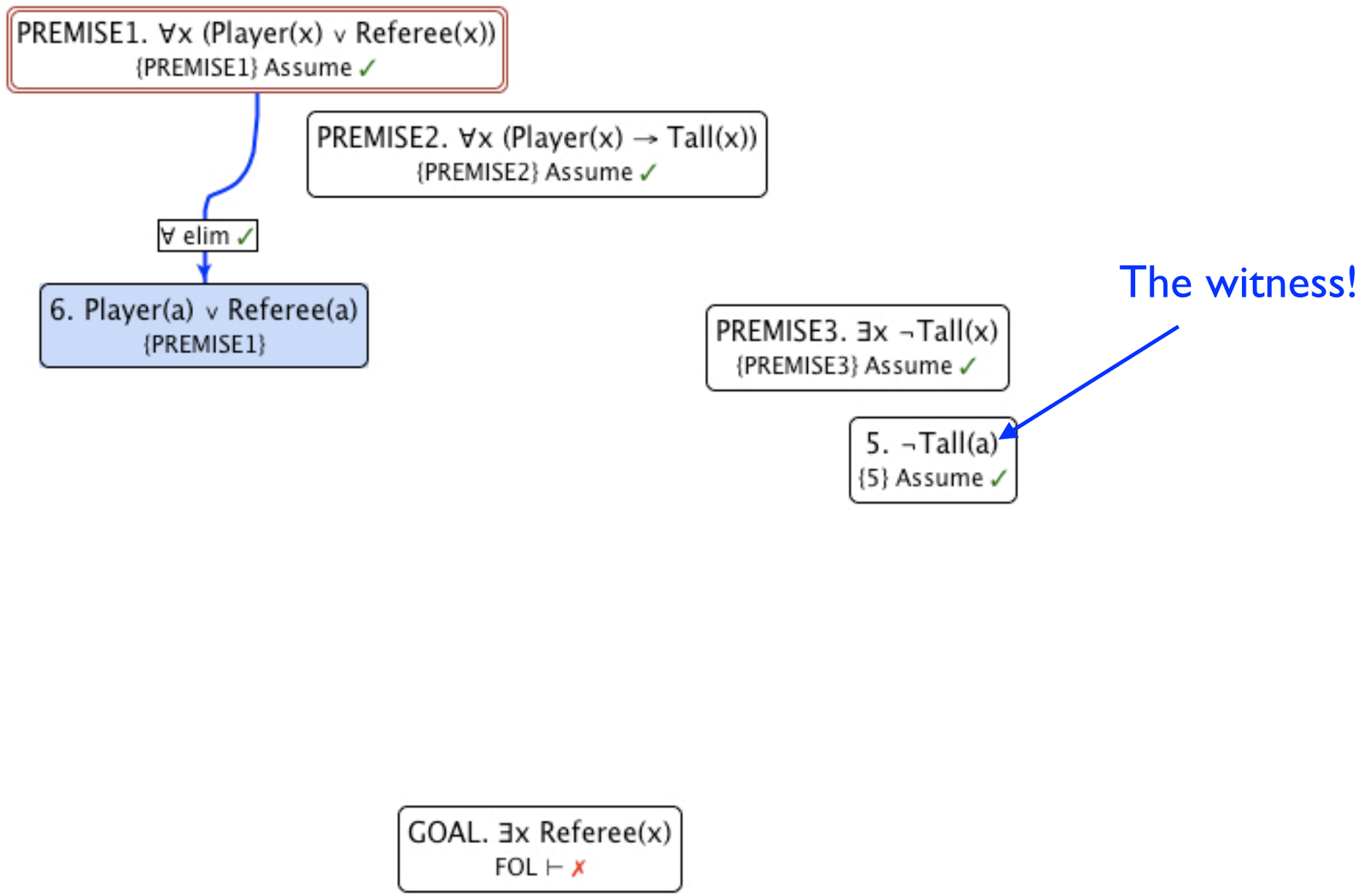
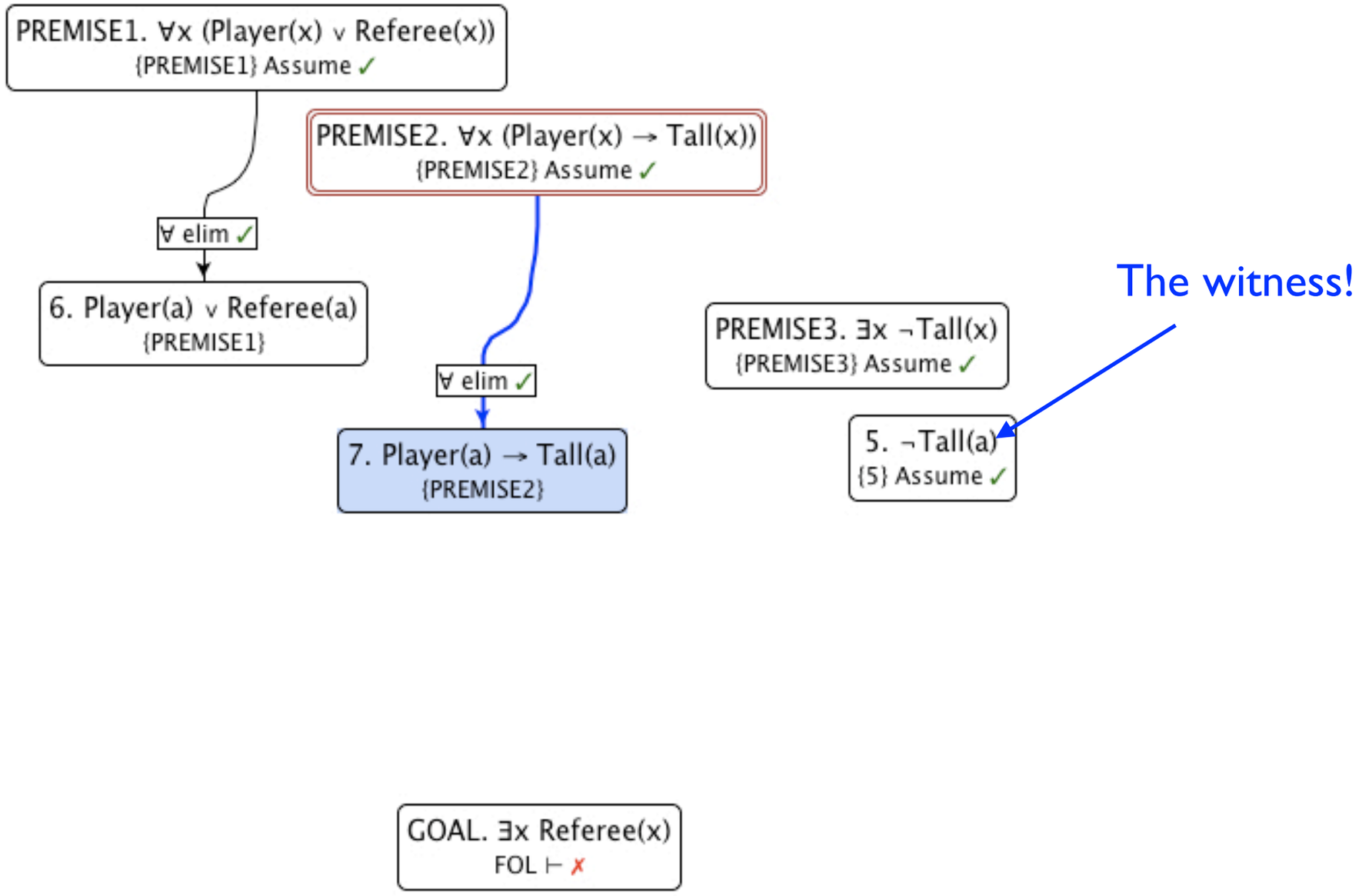
{PREMISE1} Assume ✓
PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
The witness!
5. ¬Tall(a)
{5} Assume ✓
GOAL. ∃x Referee(x)
FOL ⊢ ✗

Step 2


PREMISE1. ∀x (Player(x) ∨ Referee(x))
{PREMISE1} Assume ✓
PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓
∀ elim ✓
6. Player(a) ∨ Referee(a)
{PREMISE1}
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
The witness!
5. ¬Tall(a)
{5} Assume ✓
GOAL. ∃x Referee(x)
FOL ⊢ ✗

Step 3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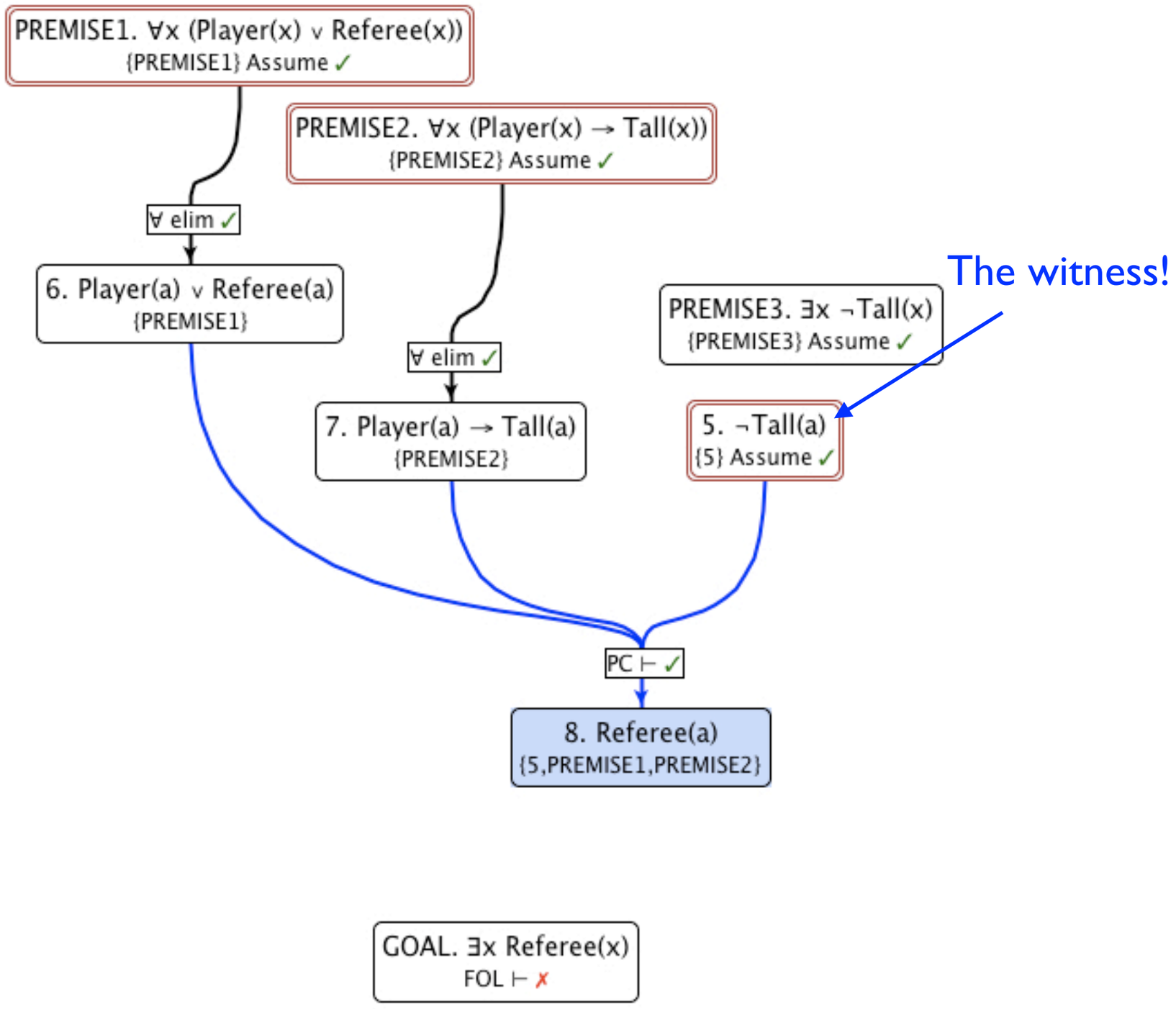
PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓
∀ elim ✓
6. Player(a) ∨ Referee(a)
{PREMISE1}
∀ elim ✓
7. Player(a) → Tall(a)
{PREMISE2}
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
The witness!
5. ¬Tall(a)
{5} Assume ✓
GOAL. ∃x Referee(x)
FOL ⊢ ✗

Step 4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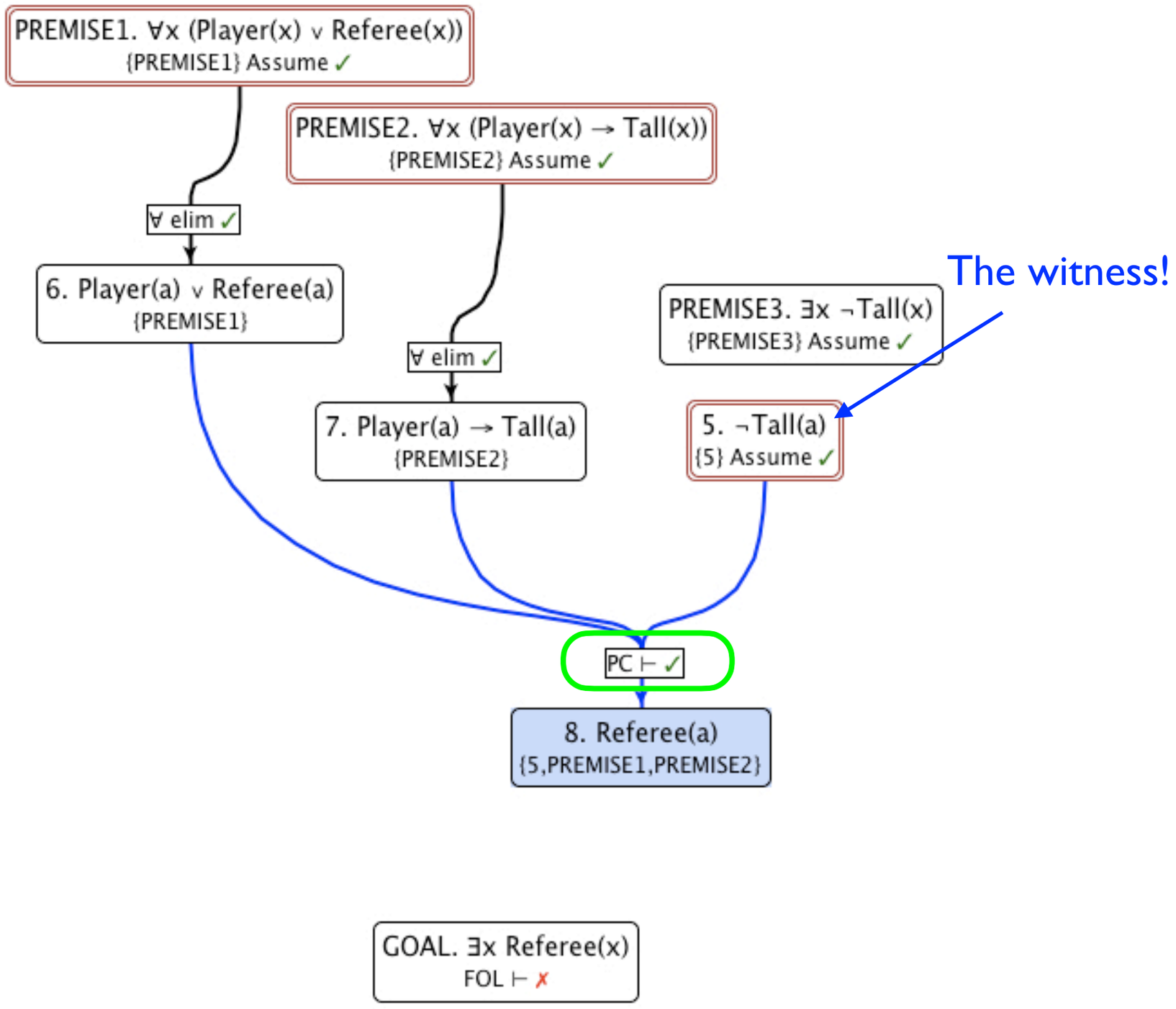
{PREMISE2} Assume ✓
∀ elim ✓
6. Player(a) ∨ Referee(a)
{PREMISE1}
∀ elim ✓
7. Player(a) → Tall(a)
{PREMISE2}
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
The witness!
5. ¬Tall(a)
{5} Assume ✓
PC ⊢ ✓
8. Referee(a)
{5,PREMISE1,PREMISE2}
GOAL. ∃x Referee(x)
FOL ⊢ ✗

Step 4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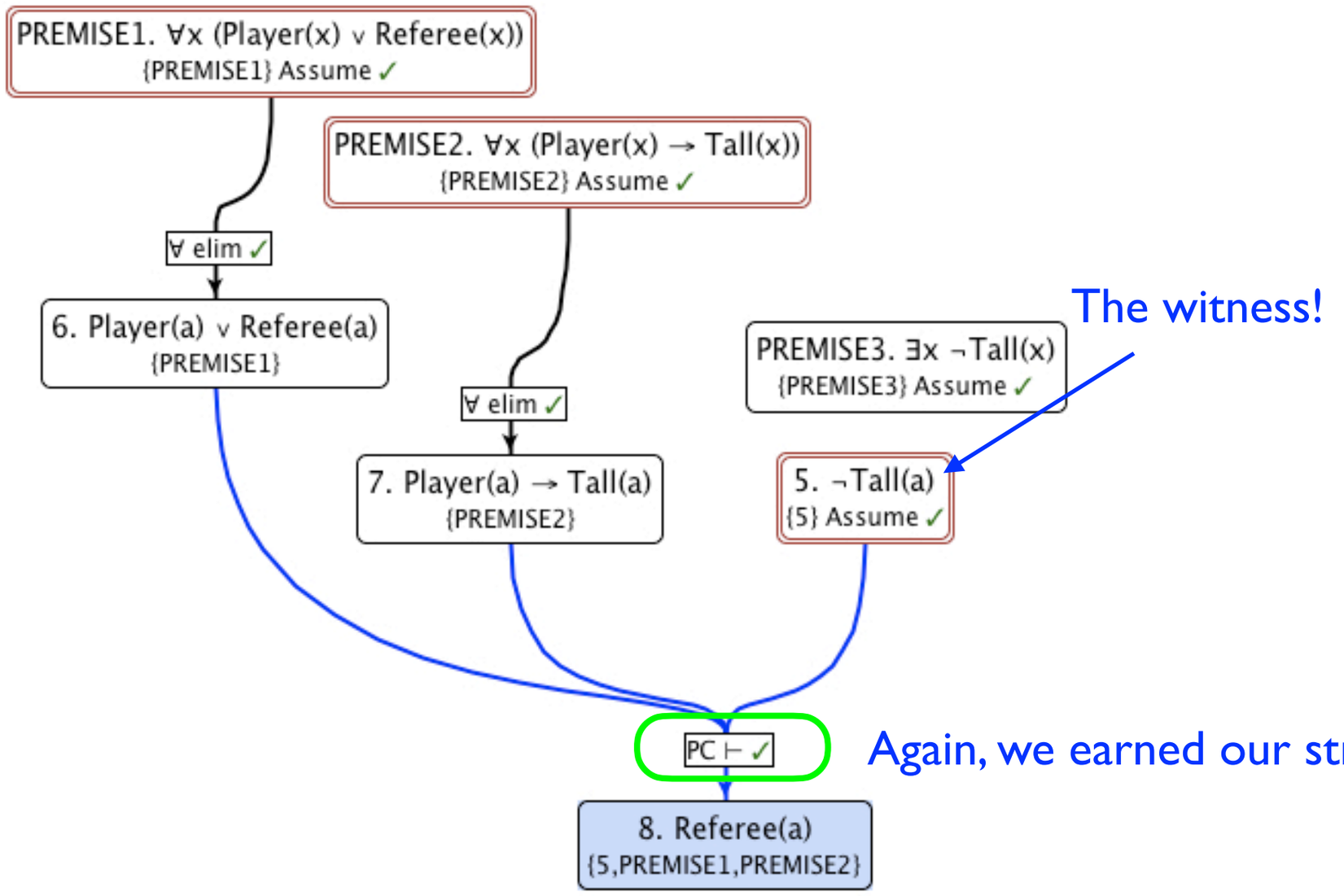
PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
The witness!
∀ elim ✓
∀ elim ✓
6. Player(a) ∨ Referee(a)
{PREMISE1}
7. Player(a) → Tall(a)
{PREMISE2}
5. ¬Tall(a)
{5} Assume ✓
PC ⊢ ✓
8. Referee(a)
{5,PREMISE1,PREMISE2}
GOAL. ∃x Referee(x)
FOL ⊢ ✗

Step 4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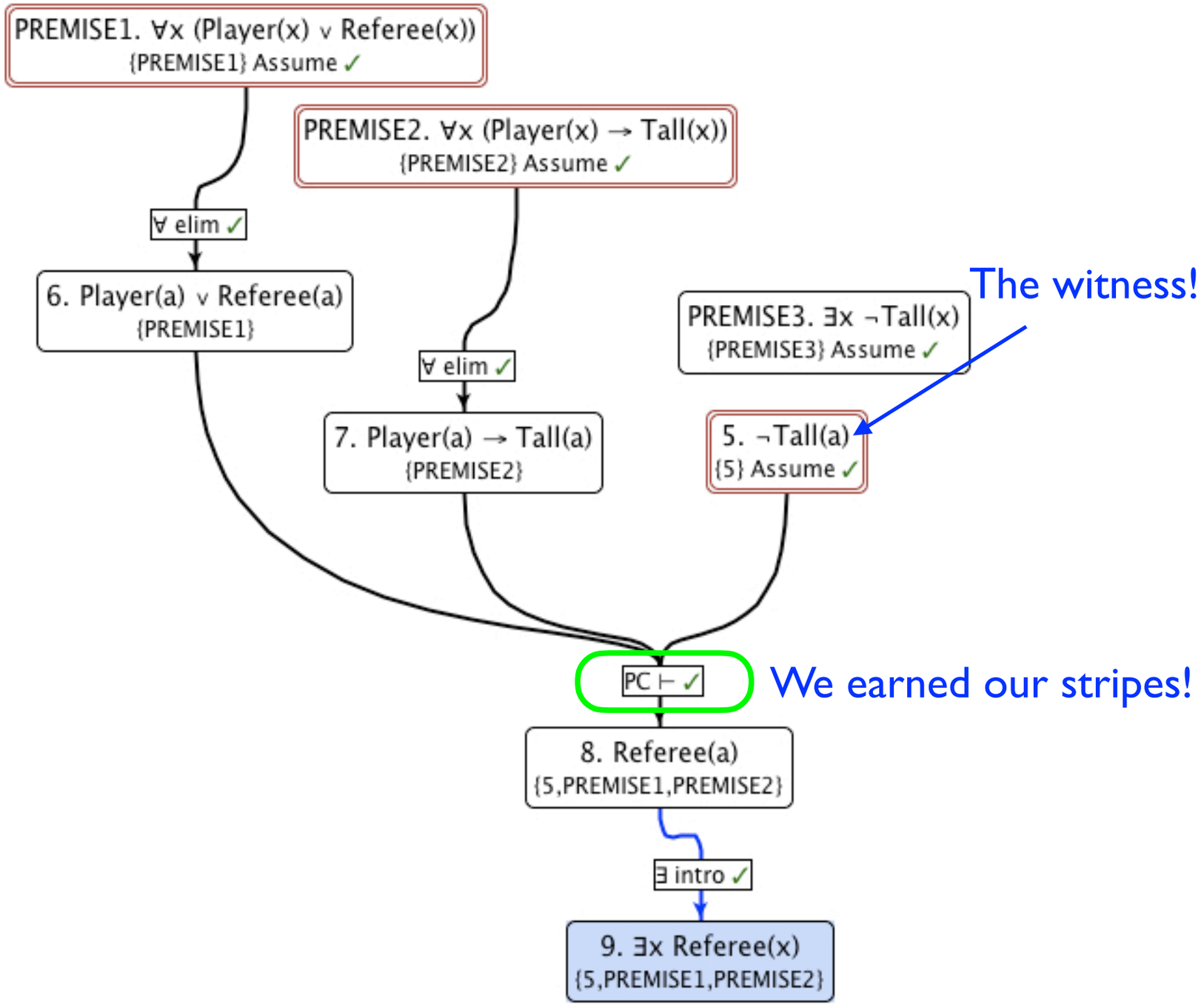
PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓
∀ elim ✓
6. Player(a) ∨ Referee(a)
{PREMISE1}
∀ elim ✓
7. Player(a) → Tall(a)
{PREMISE2}
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
The witness!
5. ¬Tall(a)
{5} Assume ✓
PC ⊢ ✓
Again, we earned our stripes!
8. Referee(a)
{5,PREMISE1,PREMISE2}
GOAL. ∃x Referee(x)
FOL ⊢ ✗

Step 5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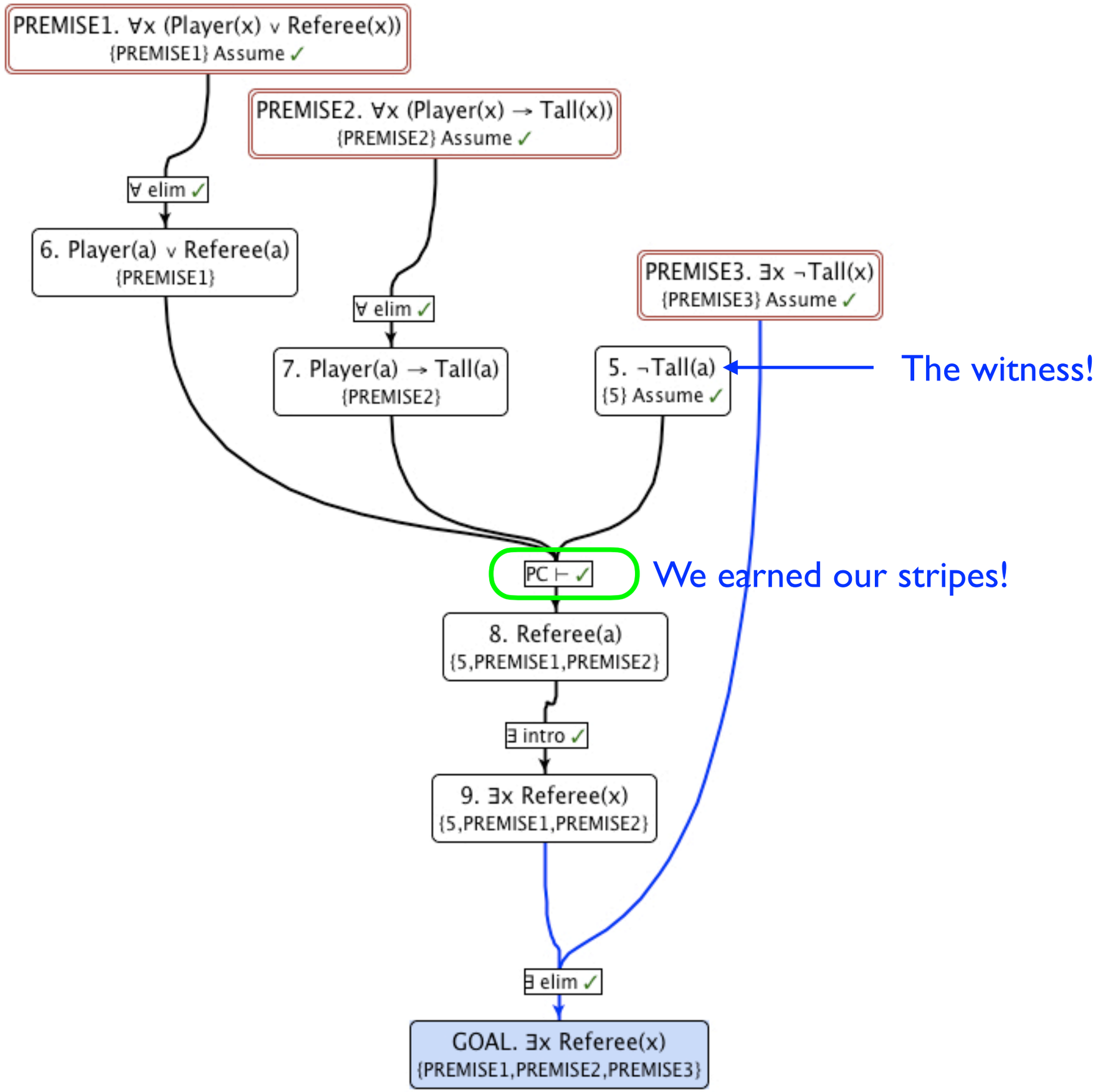
PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓
∀ elim ✓
6. Player(a) ∨ Referee(a)
{PREMISE1}
∀ elim ✓
7. Player(a) → Tall(a)
{PREMISE2}
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
The witness!
5. ¬Tall(a)
{5} Assume ✓
PC ⊢ ✓
We earned our stripes!
8. Referee(a)
{5,PREMISE1,PREMISE2}
∃ intro ✓
9. ∃x Referee(x)
{5,PREMISE1,PREMISE2}
GOAL. ∃x Referee(x)
FOL ⊢ ✗

Step 6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PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓
∀ elim ✓
6. Player(a) ∨ Referee(a)
{PREMISE1}
∀ elim ✓
7. Player(a) → Tall(a)
{PREMISE2}
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
5. ¬Tall(a)
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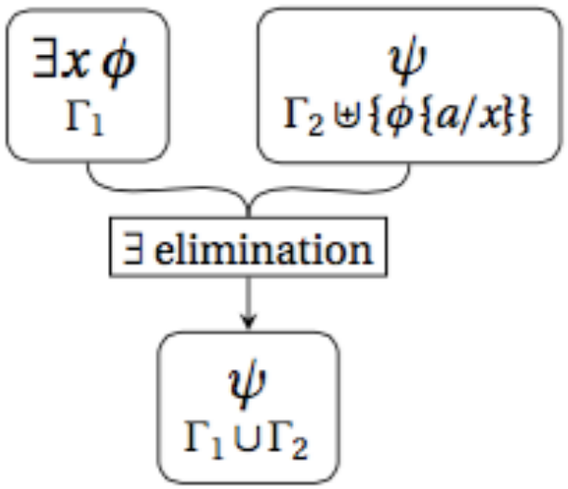
The witness!
PC ⊢ ✓
We earned our stripes!
8. Referee(a)
{5,PREMISE1,PREMISE2}
∃ intro ✓
9. ∃x Referee(x)
{5,PREMISE1,PREMISE2}
∃ elim ✓
GOAL. ∃x Referee(x)
{PREMISE1,PREMISE2,PREMISE3}

Step 6


$\exists x\,\phi$
Γ_1
ψ
$\Gamma_2 \uplus \{\phi\{a/x\}\}$
∃ elimination
ψ
$\Gamma_1 \cup \Gamma_2$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PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓
∀ elim ✓
6. Player(a) ∨ Referee(a)
{PREMISE1}
∀ elim ✓
7. Player(a) → Tall(a)
{PREMISE2}
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
5. ¬Tall(a)
{5} Assume ✓
The witness!
PC ⊢ ✓
We earned our stripes!
8. Referee(a)
{5,PREMISE1,PREMISE2}
∃ intro ✓
9. ∃x Referee(x)
{5,PREMISE1,PREMISE2}
∃ elim ✓
GOAL. ∃x Referee(x)
{PREMISE1,PREMISE2,PREMISE3}

Step 6

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{PREMISE1} Assume ✓

PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓

∀ elim ✓

6. Player(a) ∨ Referee(a)
{PREMISE1}

∀ elim ✓

7. Player(a) → Tall(a)
{PREMISE2}

PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓

5. ¬Tall(a)
{5} Assume ✓

The witness!

PC ⊢ ✓

We earned our stripes!

8. Referee(a)
{5,PREMISE1,PREMISE2}

∃ intro ✓

9. ∃x Referee(x)
{5,PREMISE1,PREMISE2}

∃ elim ✓

GOAL. ∃x Referee(x)
{PREMISE1,PREMISE2,PREMISE3}

$\exists x\, \phi$
Γ_1

ψ
$\Gamma_2 \uplus \{\phi\{a/x\}\}$

∃ elimination

ψ
$\Gamma_1 \cup \Gamma_2$

Step 6

PREMISE1. ∀x (Player(x) ∨ Referee(x))
{PREMISE1} Assume ✓

PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓

∀ elim ✓

6. Player(a) ∨ Referee(a)
{PREMISE1}

∀ elim ✓

7. Player(a) → Tall(a)
{PREMISE2}

PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓

5. ¬Tall(a)
{5} Assume ✓

The witness!

PC ⊢ ✓

We earned our stripes!

8. Referee(a)
{5,PREMISE1,PREMISE2}

∃ intro ✓

9. ∃x Referee(x)
{5,PREMISE1,PREMISE2}

∃ elim ✓

GOAL. ∃x Referee(x)
{PREMISE1,PREMISE2,PREMISE3}

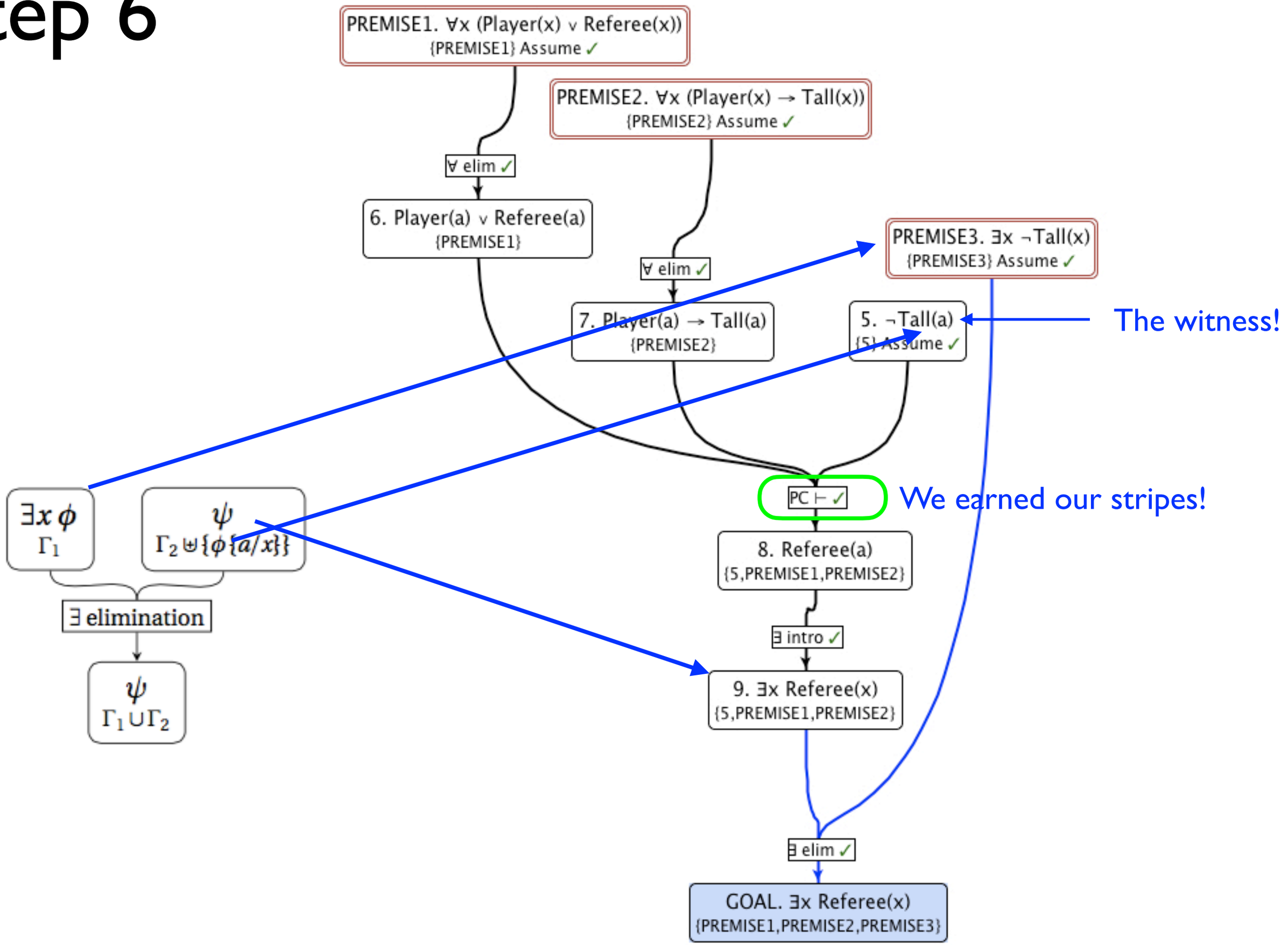
$\exists x\, \phi$
Γ_1

ψ
$\Gamma_2 \uplus \{\phi\{a/x\}\}$

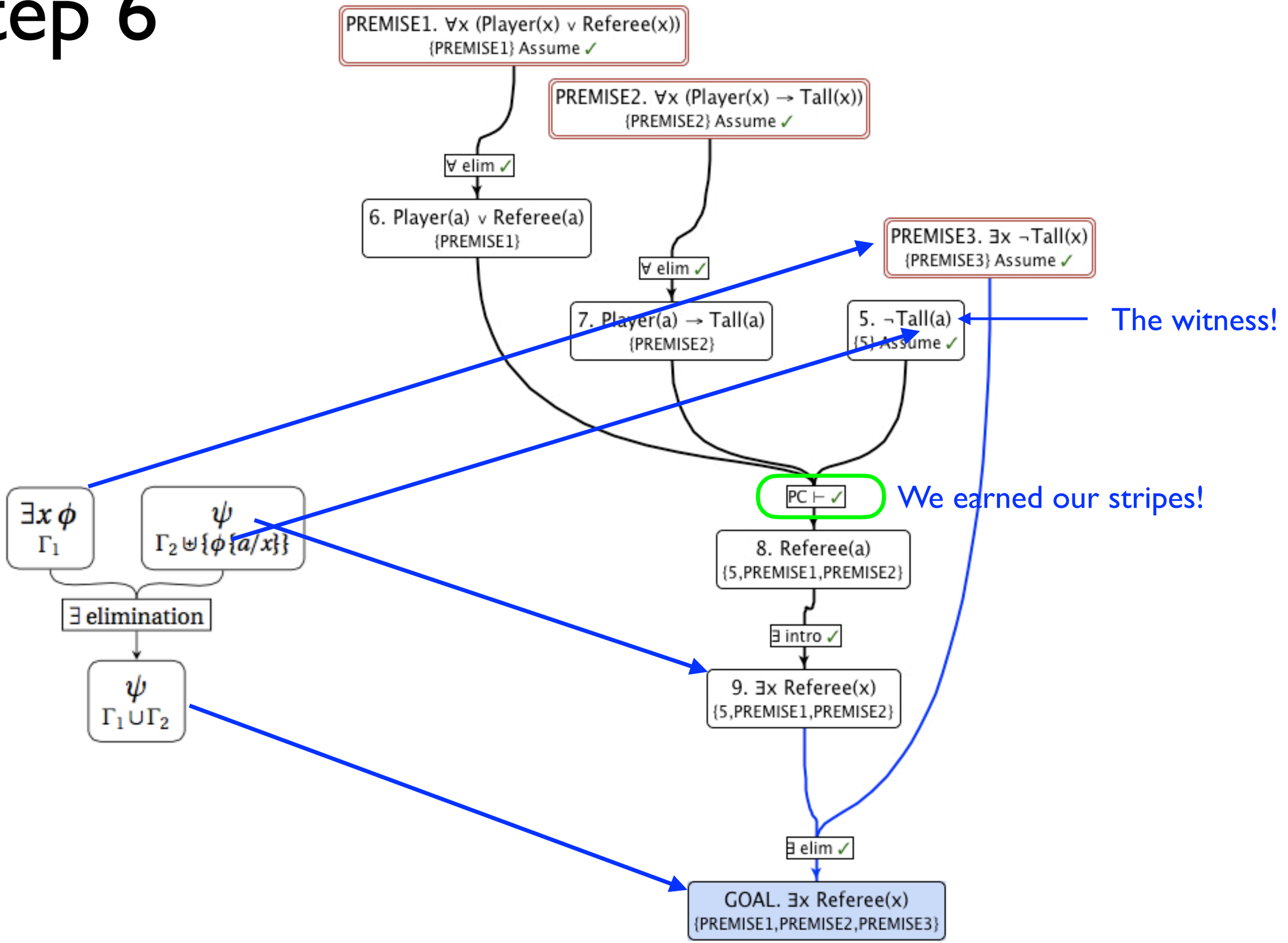
∃ elimination

ψ
$\Gamma_1 \cup \Gamma_2$

Step 6


PREMISE1. ∀x (Player(x) ∨ Referee(x))
{PREMISE1} Assume ✓
PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓
∀ elim ✓
6. Player(a) ∨ Referee(a)
{PREMISE1}
∀ elim ✓
7. Player(a) → Tall(a)
{PREMISE2}
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
5. ¬Tall(a)
{5} Assume ✓
The witness!
PC ⊢ ✓
We earned our stripes!
8. Referee(a)
{5,PREMISE1,PREMISE2}
∃ intro ✓
9. ∃x Referee(x)
{5,PREMISE1,PREMISE2}
∃ elim ✓
GOAL. ∃x Referee(x)
{PREMISE1,PREMISE2,PREMISE3}
$\exists x\,\phi$
Γ_1
ψ
$\Gamma_2 \uplus \{\phi\{a/x\}\}$
∃ elimination
ψ
$\Gamma_1 \cup \Gamma_2$

Step 6


PREMISE1. ∀x (Player(x) ∨ Referee(x))
{PREMISE1} Assume ✓
PREMISE2. ∀x (Player(x) → Tall(x))
{PREMISE2} Assume ✓
∀ elim ✓
6. Player(a) ∨ Referee(a)
{PREMISE1}
∀ elim ✓
7. Player(a) → Tall(a)
{PREMISE2}
PREMISE3. ∃x ¬Tall(x)
{PREMISE3} Assume ✓
5. ¬Tall(a)
{5} Assume ✓
The witness!
PC ⊢ ✓
We earned our stripes!
8. Referee(a)
{5,PREMISE1,PREMISE2}
∃ intro ✓
9. ∃x Referee(x)
{5,PREMISE1,PREMISE2}
∃ elim ✓
GOAL. ∃x Referee(x)
{PREMISE1,PREMISE2,PREMISE3}
$\exists x\,\phi$
Γ_1
ψ
$\Gamma_2 \uplus \{\phi\{a/x\}\}$
∃ elimination
ψ
$\Gamma_1 \cup \Gamma_2$

$$\{\forall \mathtt{x}(\mathtt{Scared}(\mathtt{x}) \leftrightarrow \mathtt{Small}(\mathtt{x})), \exists \mathtt{x} \neg \mathtt{Scared}(x)\} \vdash \exists \mathtt{x} \neg \mathtt{Small}(x)$$

$$\{\exists \mathtt{x}, \mathtt{yContiguous}(\mathtt{x}, \mathtt{y}), \forall \mathtt{x}, \mathtt{y}(\mathtt{Contiguous}(\mathtt{x}, \mathtt{y}) \rightarrow \neg \mathtt{SameCountry}(\mathtt{x}, \mathtt{y}))\} \vdash \exists \mathtt{x}, \mathtt{y} \neg \mathtt{SameCountry}(\mathtt{x}, \mathtt{y})$$

Hvis du forstår det, kan du bevise det.