VeriSLO IP Midterm Presentation

Thibaut Blanc Amaury Mazoyer Juliette Ponsonnet Hugo Salou

École Normale Supérieure de Lyon, IP Project

November 12 2025

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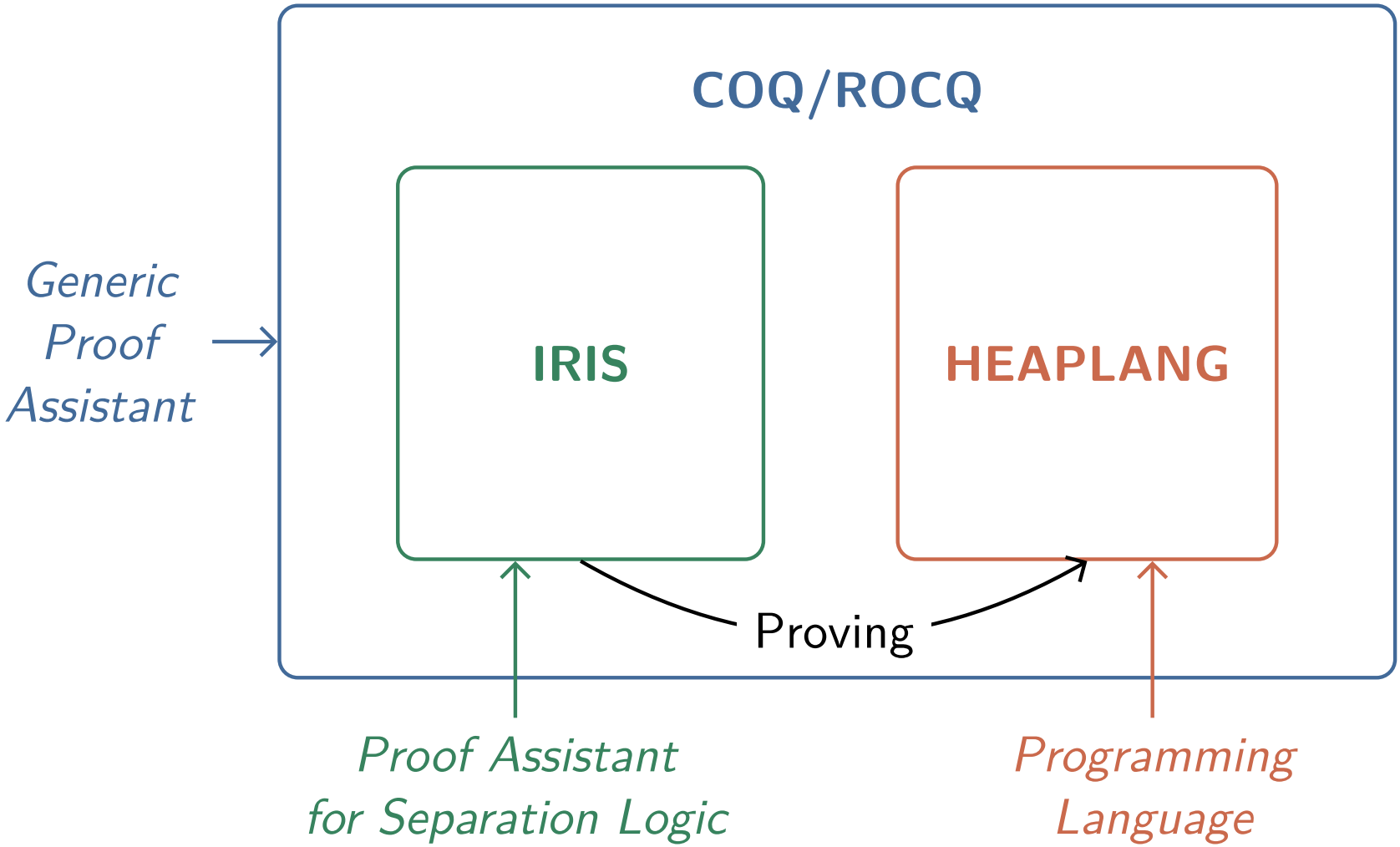
Why this Tool?

- Software correctness is crucial
- Testing is insufficient:
  - It finds bugs but does not prove their absence
  - Limited coverage of execution cases
- Formal verification:
  - The machine checks for the absence of reasoning errors
  - Can reason directly about the implementation

Rocq and Iris



Issues We Address

"At present, our proofs rely on a manual transcription of our OCaml code into HeapLang. In future work, it would be desirable to use an automated translation, such as those offered by Zoo [All25] or Osiris [Sea+25].
We have encountered serious performance problems with the current implementation of Iris on top of Rocq. Iris's tactics can be very slow and can fail to terminate for unknown reasons; sometimes a change causes divergence in a seemingly unrelated part of the proof. Although we have eventually worked around or tolerated these problems, they have made our progress much slower and more painful than expected."

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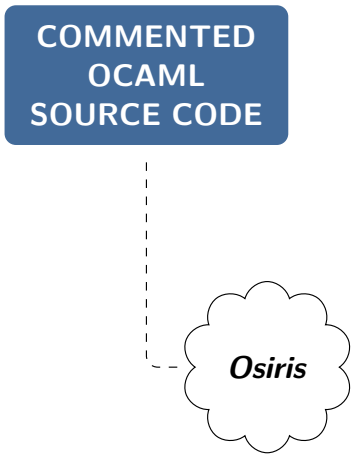
SOURCE CODE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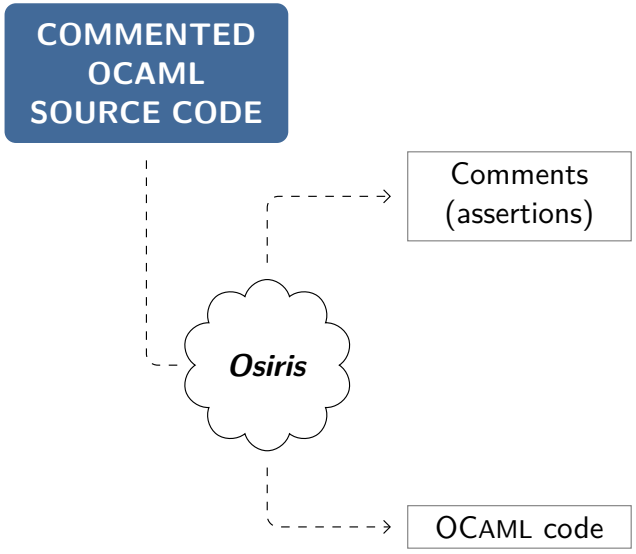
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Comments
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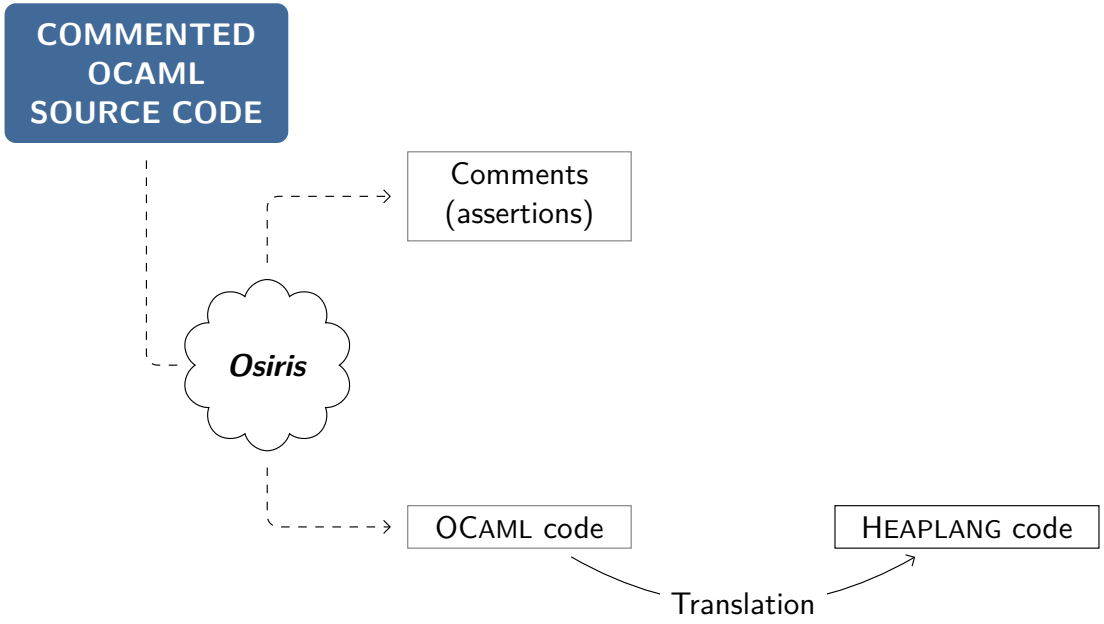
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OCaml code
HeapLang code
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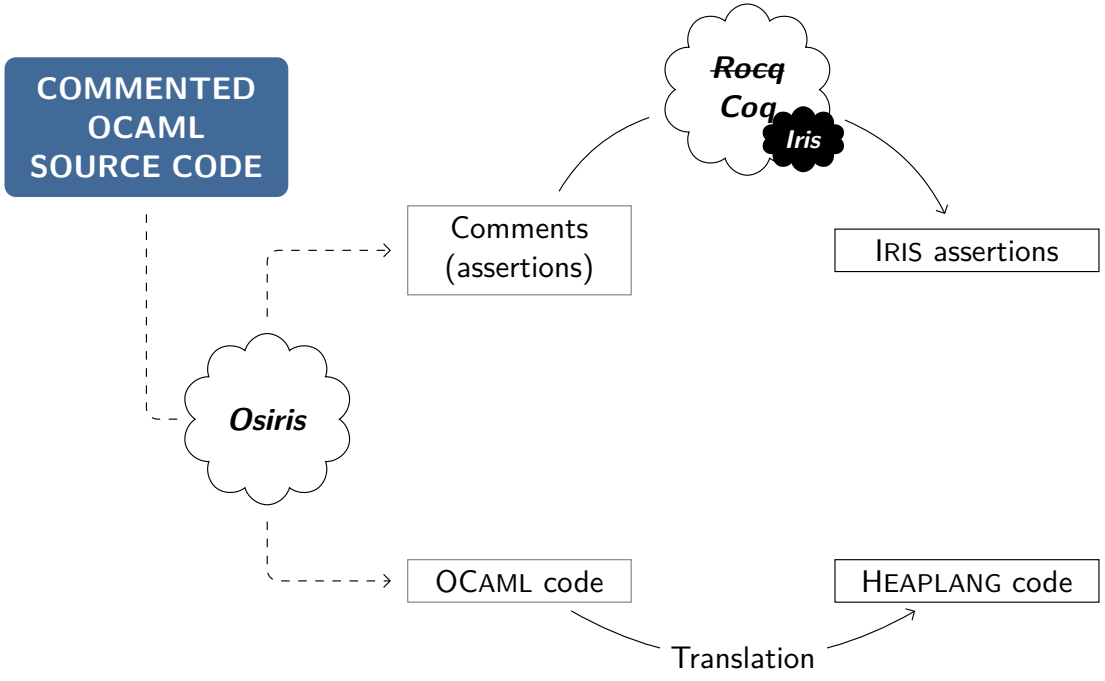
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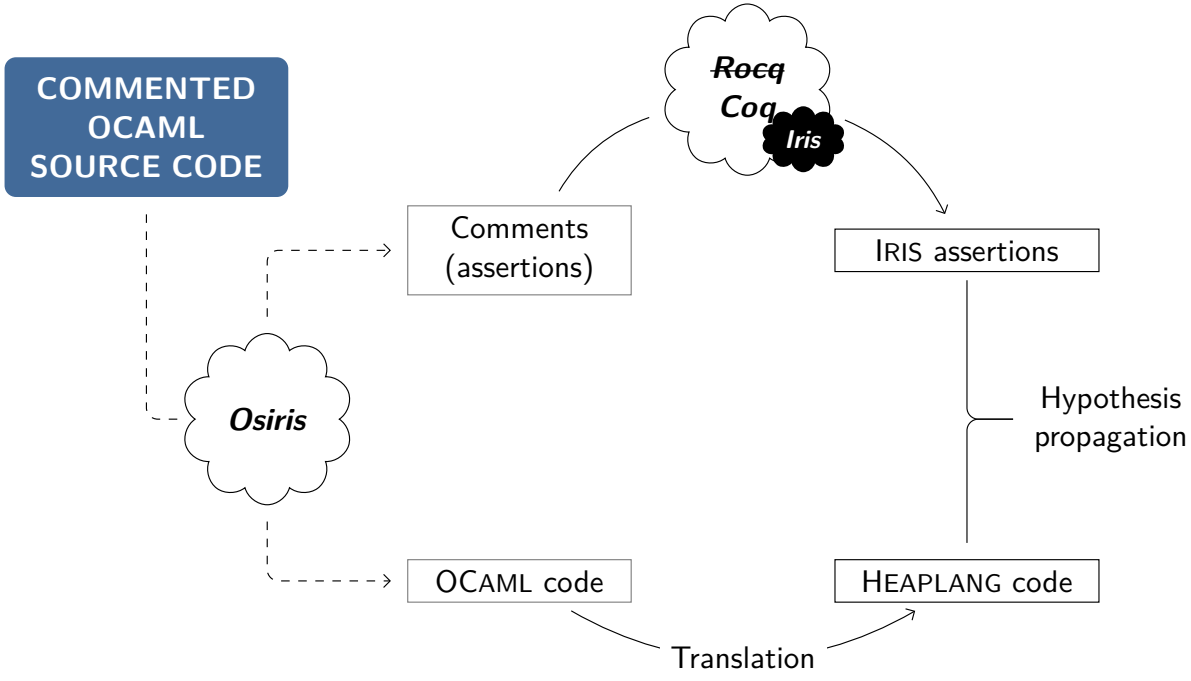
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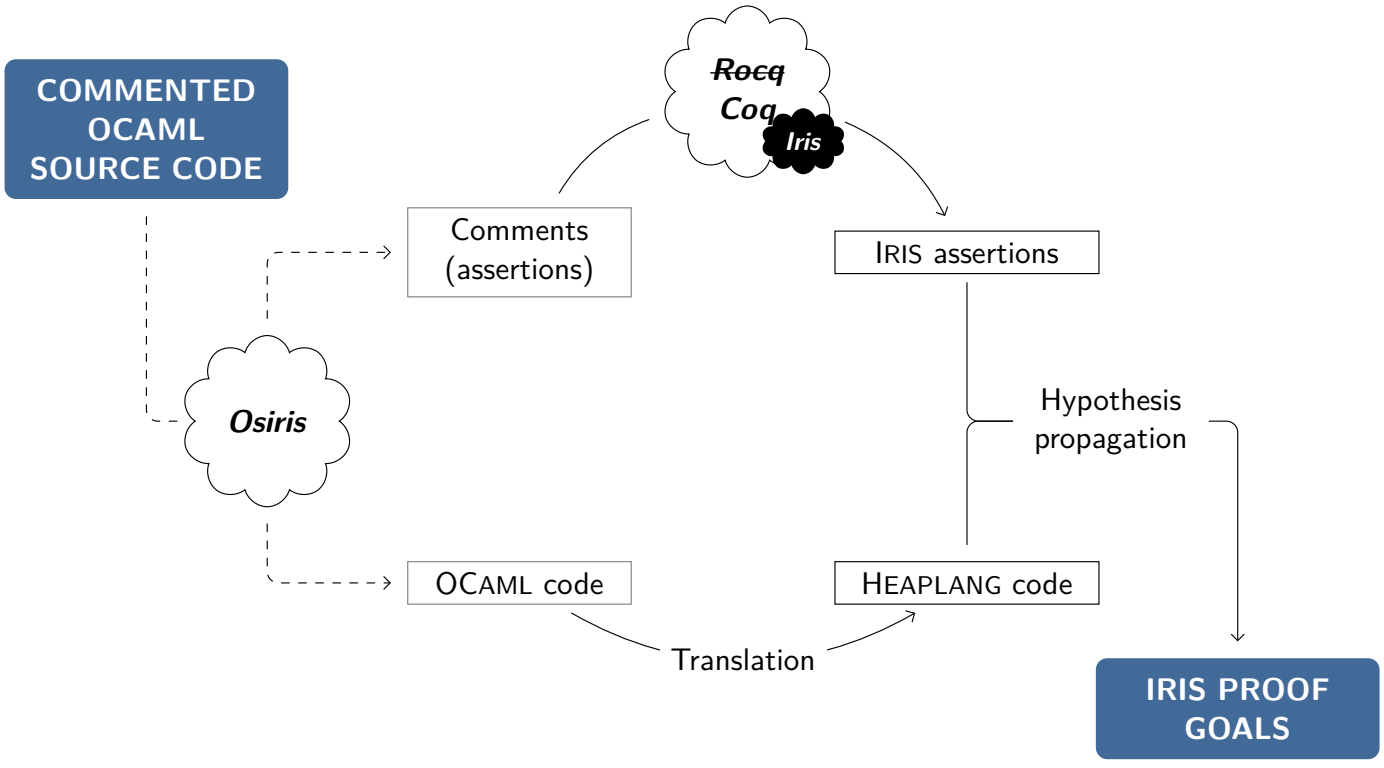
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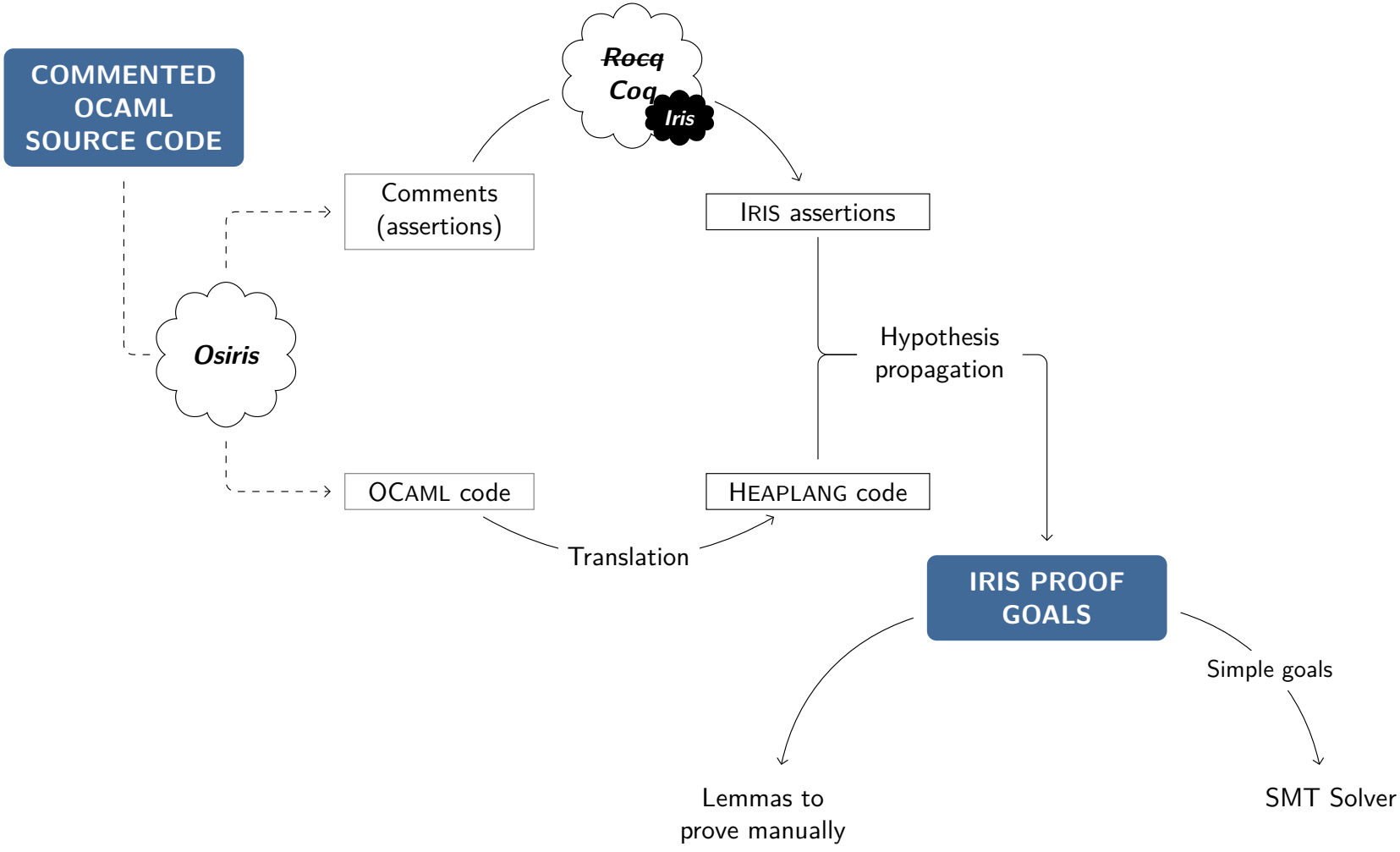
IRIS PROOF GOALS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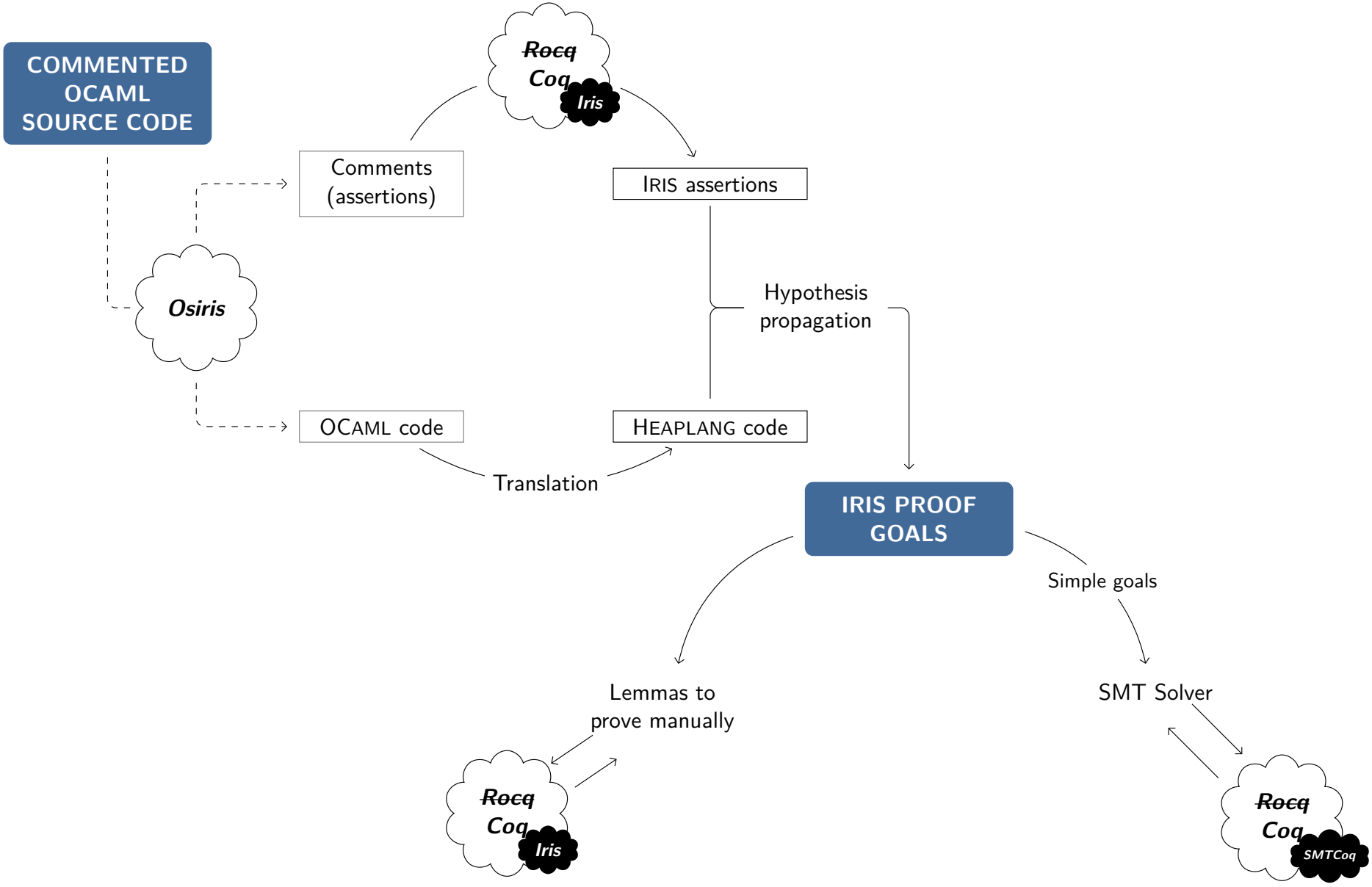
IRIS PROOF GOALS
Simple goals
Lemmas to prove manually
SMT Solver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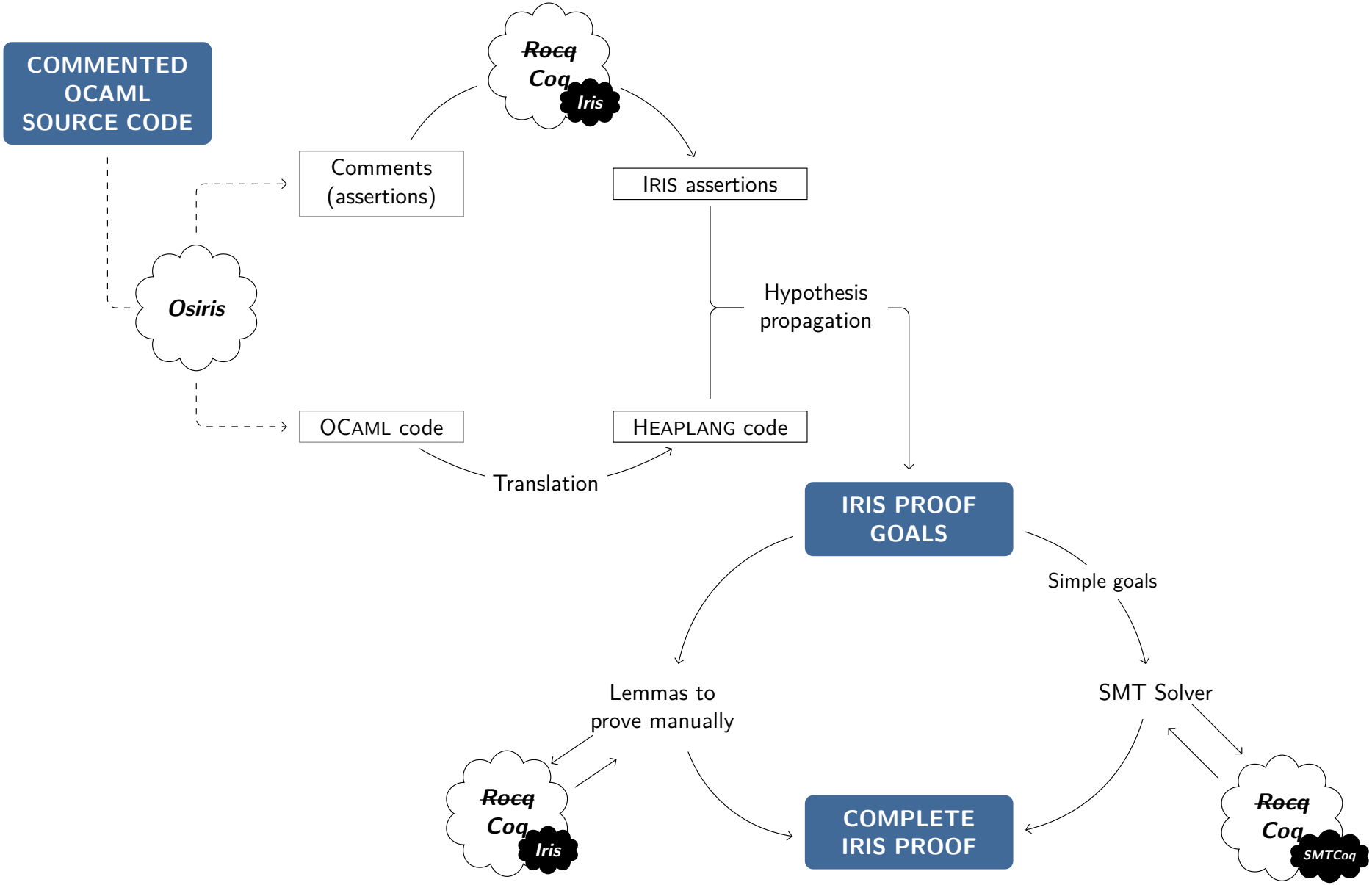
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A Small Program

```
let result =
    let x = ref 1 in
    if !x <= 2
        then x := 3;
    !x
    [@ret "y"] [@post "⌜y = #3⌝"]
```

Listing. *A simple annotated OCaml program*

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Listing. *A simple annotated OCaml program*

```
⊢  ∀z : val,
   (⌜(#1 ≤ᵥ #2) = (z ≤ᵥ #2)⌝
   ∗ ⌜(z ≤ᵥ #2) = #false⌝)
   -∗ ⌜#1 = #3⌝
```

Listing. *The Iris proof obligation generated*

Loops and Complex Proofs

```
[@@@vernac "Require Import my_header."]

let [@post "x ↦ 12"] result =
  let x = ref 0 in
  while !x <= 10 do
    x := !x + 2;
  done
  [@invariant "x ↦ z ∗ ⌜even z⌝"]
```

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From OCaml to HeapLang

```
let result =
    let x = ref 1 in
    if !x <= 2
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    !x
```

Listing. *A simple OCaml program*

```
Definition result : expr := (
    let: "x" := AllocN #1 #1 in
    if: (!"x" ≤ #2) then (
        "x" <- #3
    ) else (
        #()
    );;
    !"x"
).
```

Listing. *Generated HeapLang code*

Control Flow Tree (CFT)

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let result =
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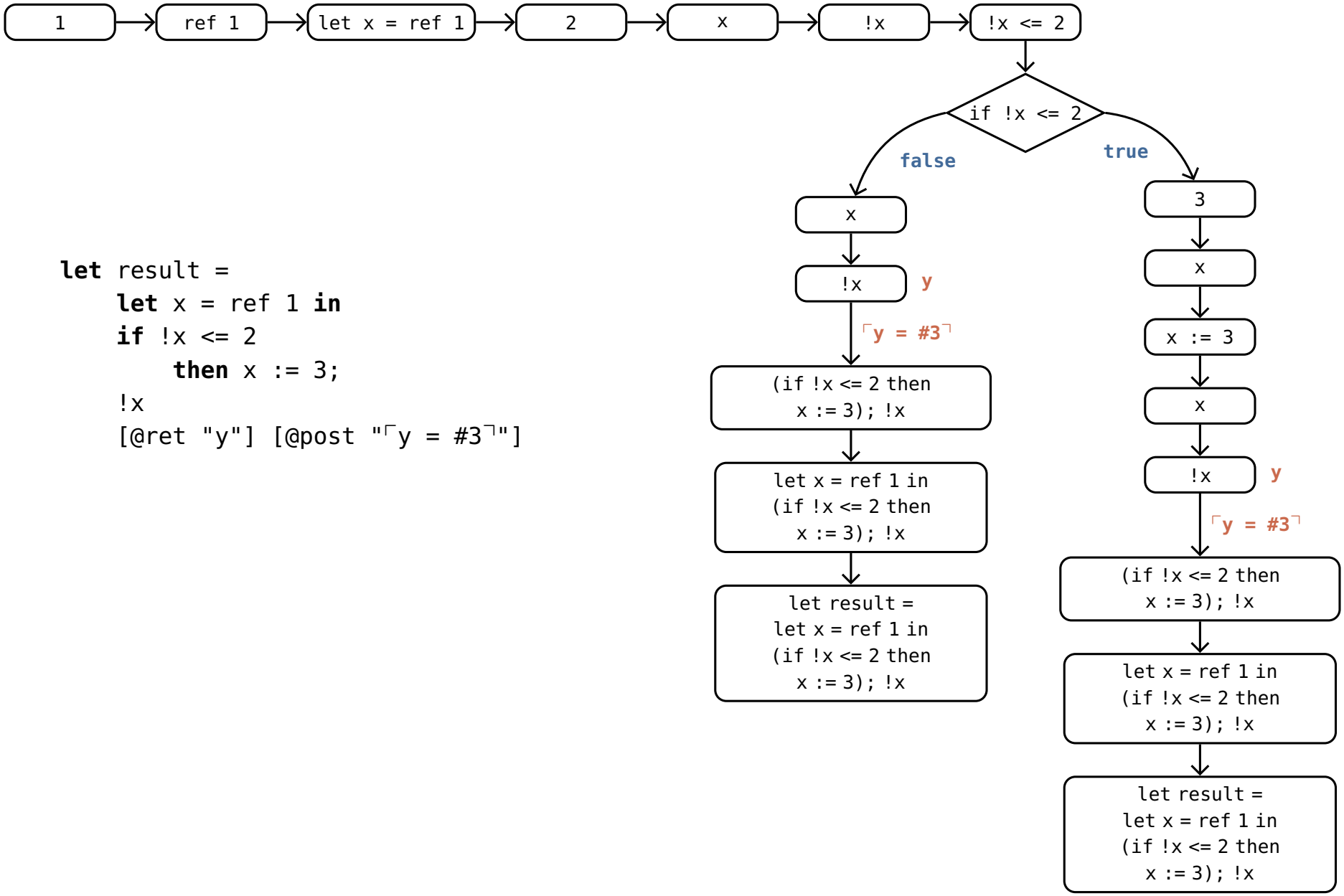

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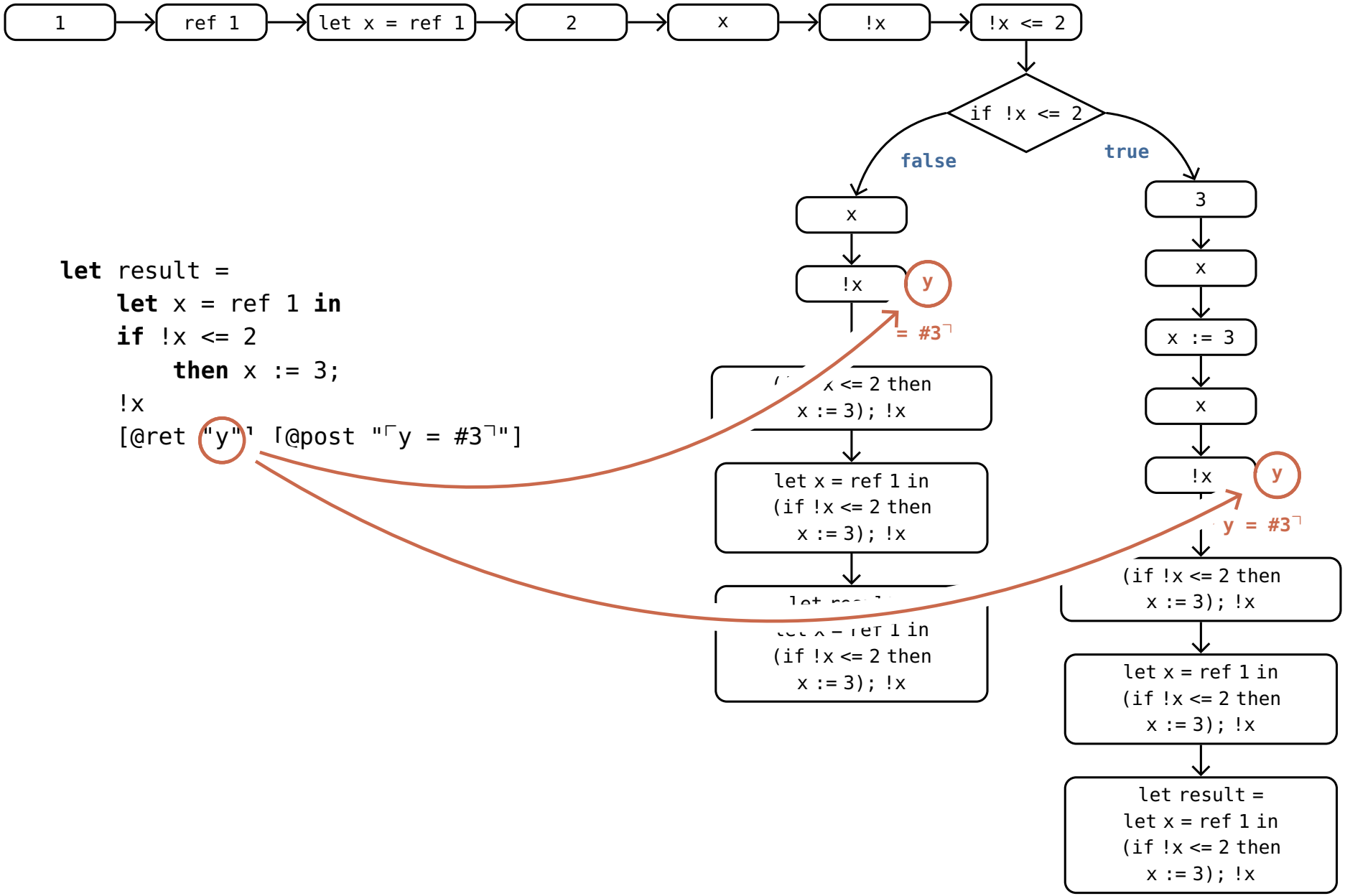

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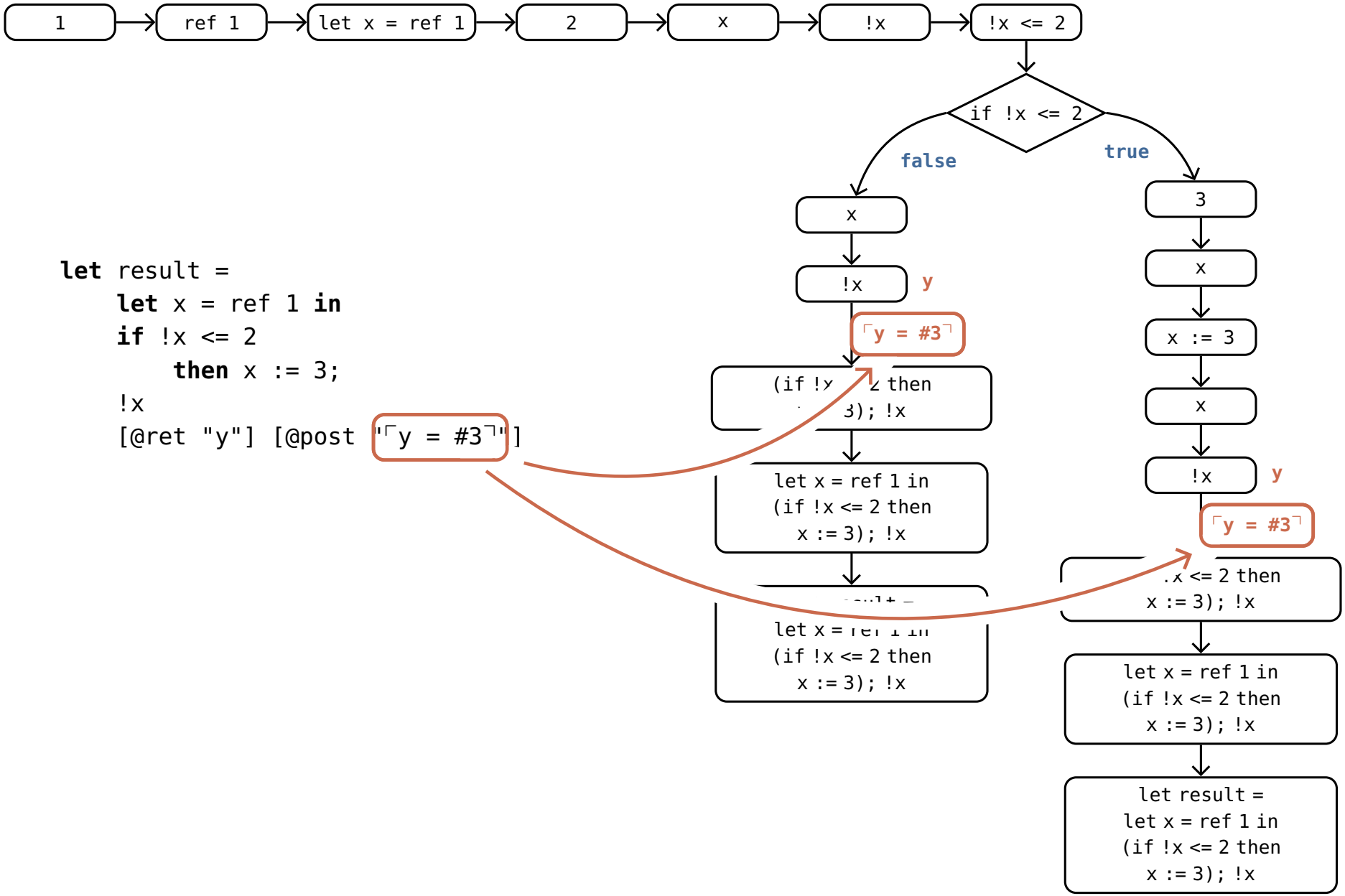
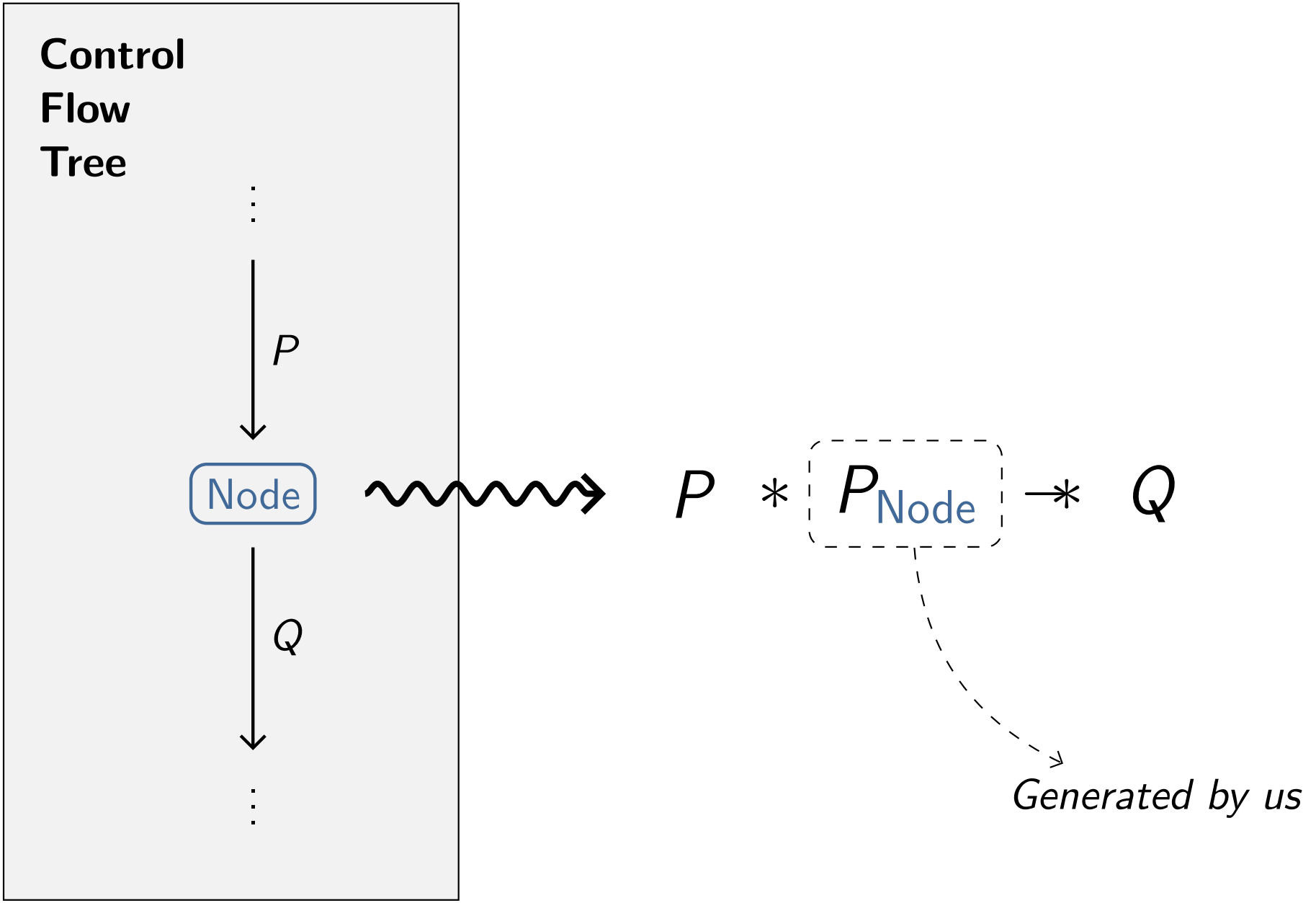
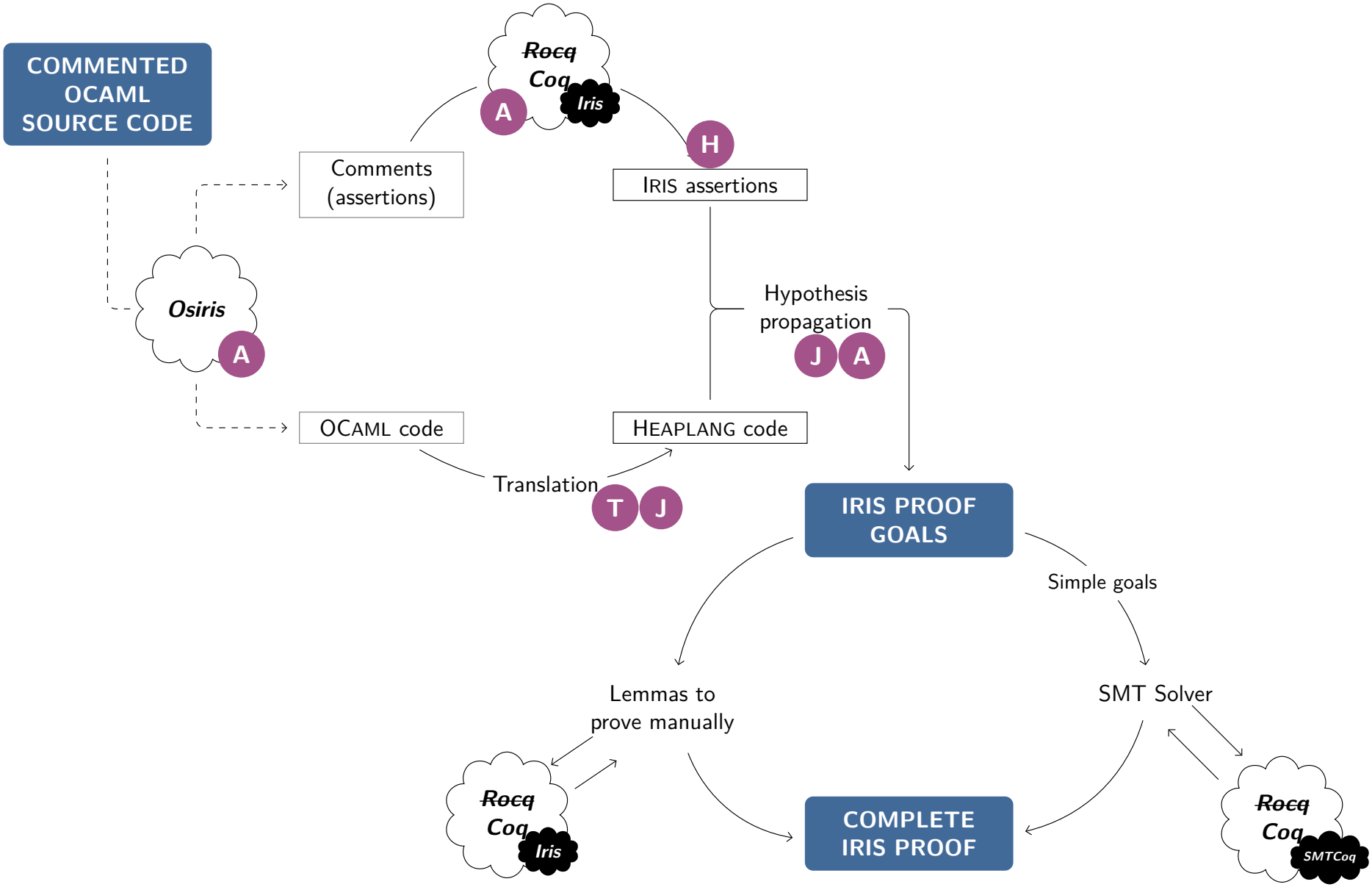


Obligation Generation



Team Organisation



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[All25] Clément Allain. “Zoo: A framework for the verification of concurrent OCaml 5 programs using separation logic”. In: *Journées Françaises des Langages Applicatifs (JFLA)*. Jan. 2025. URL: https://clef-men.github.io/publications/allain-25.pdf.

[Sea+25] Remy Seassau et al. “Formal Semantics and Program Logics for a Fragment of OCaml”. In: *Proceedings of the ACM on Programming Languages* 9.ICFP (Aug. 2025). URL: http://cambium.inria.fr/~fpottier/publis/seassau-yoon-madiot-pottier-osiris-2025.pdf.