# LoopInvGen:

# Data-Driven Loop Invariant Inference using Learned Features

*SyGuS-COMP 2017*

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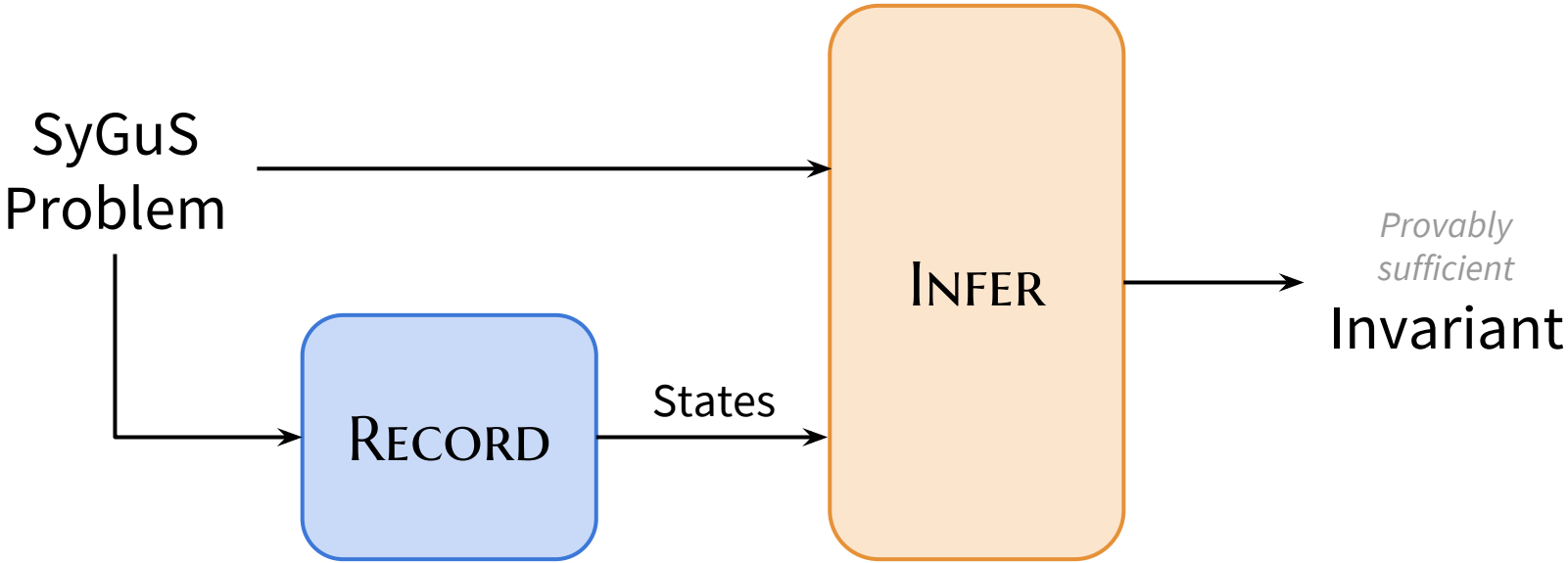
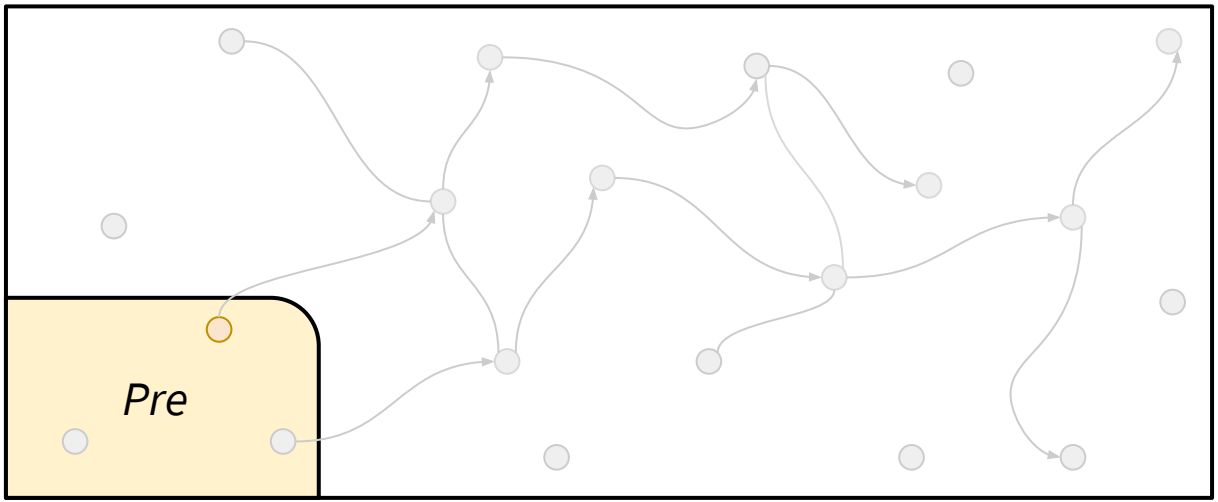
# Overview


SyGuS
Problem
Record
States
Infer
Provably
sufficient
Invariant

# RECORD-ing Reachable States

SyGuS Problem (Pre, Trans, Post) →List of variable assignments




1. Pick state s, s.t. Pre(s)

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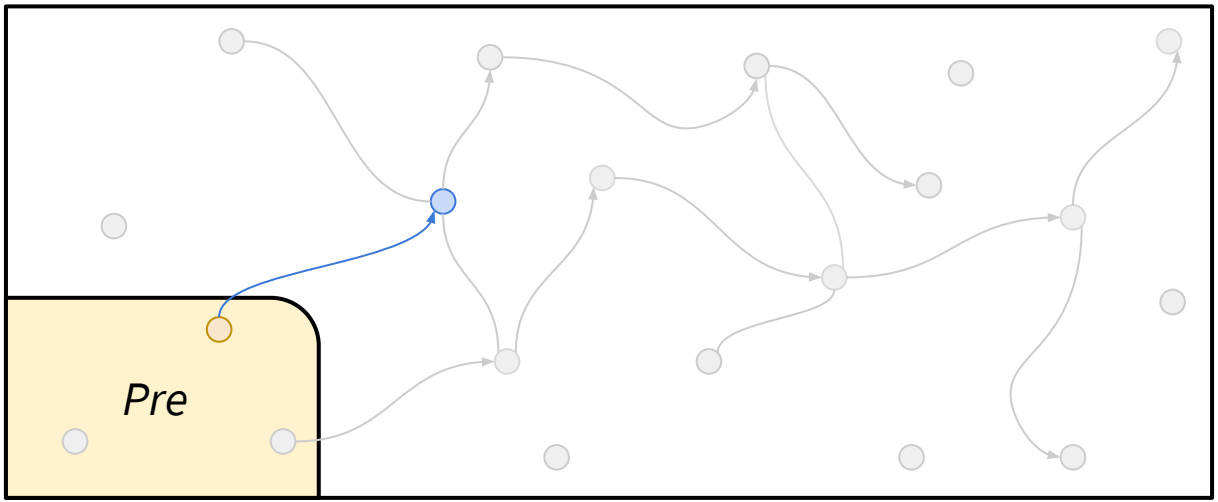
SyGuS Problem (Pre, Trans, Post) →List of variable assignments




1. Pick state s, s.t. Pre(s)

2. Obtain state t, s.t. Trans(s,t)

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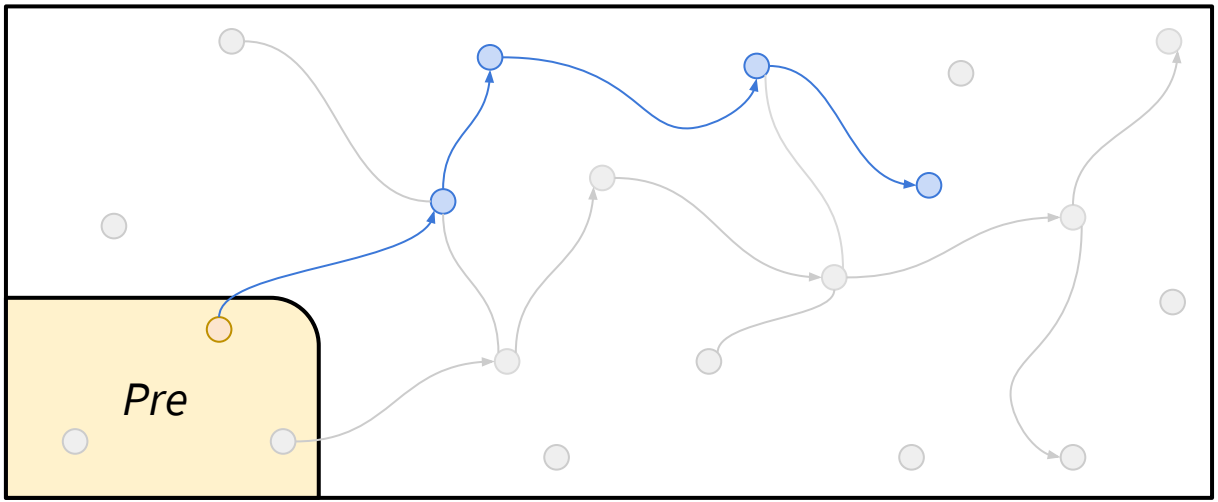


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3. Set s ← t and repeat (2)

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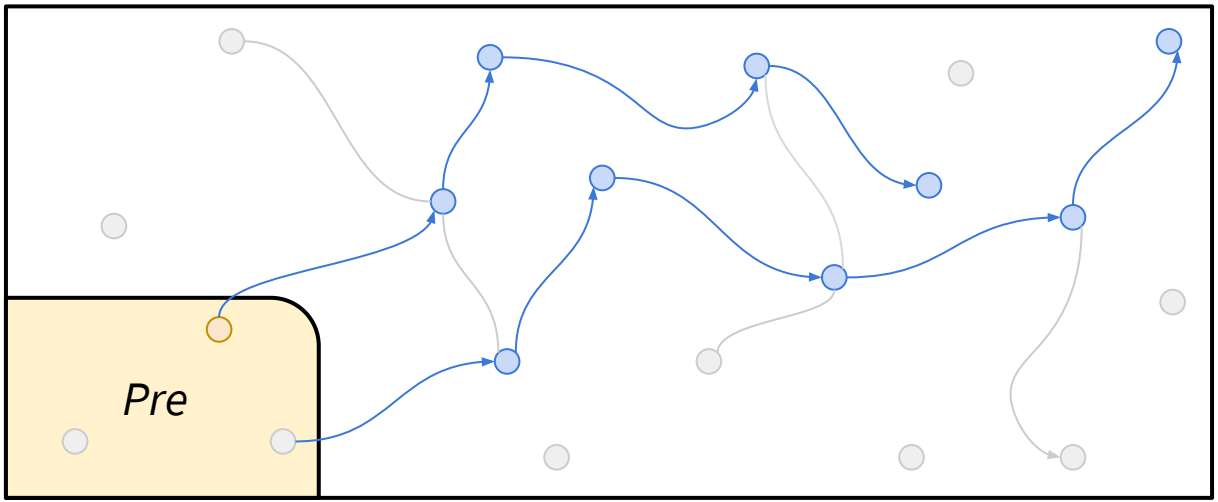
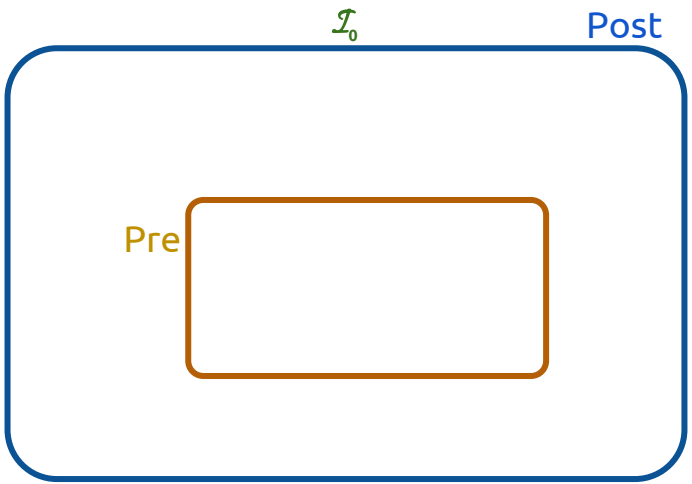



1. Pick state s, s.t. Pre(s)  2. Obtain state t, s.t. Trans(s,t)  3. Set s ← t and repeat (2)

4. Repeat (1,2,3) till the desired number of states has been collected

# INFER-ing Sufficient Invariants

- ∀ s: Pre(s) ⇒ $\mathcal{I}$(s)
- ∀ s, t: $\mathcal{I}$(s) ∧ Trans(s,t) ⇒ $\mathcal{I}$(t)
- ∀ s: $\mathcal{I}$(s) ⇒ Post(s)




1. Start with the weakest candidate

$\mathcal{I}_0$ = Post

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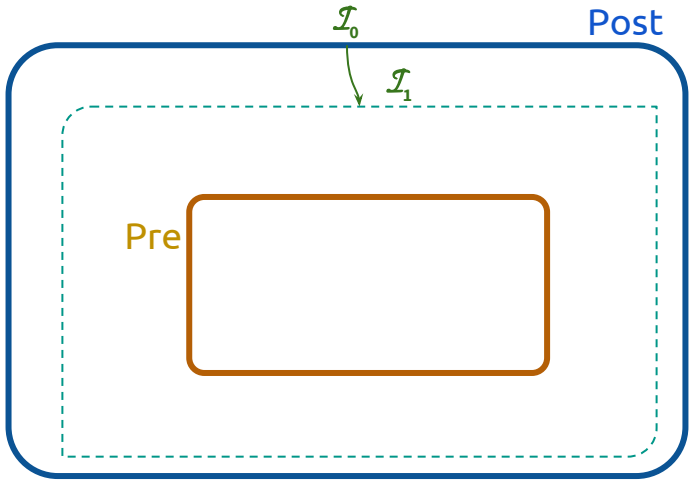


1. Start with the weakest candidate
2. Iteratively <u>strengthen</u> for inductiveness (by using precondition inference)

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$\delta_0 \Rightarrow (\mathcal{I}_0 \wedge \text{Trans} \Rightarrow \mathcal{I}_0')$

$\mathcal{I}_1 = \delta_0 \wedge \mathcal{I}_0$

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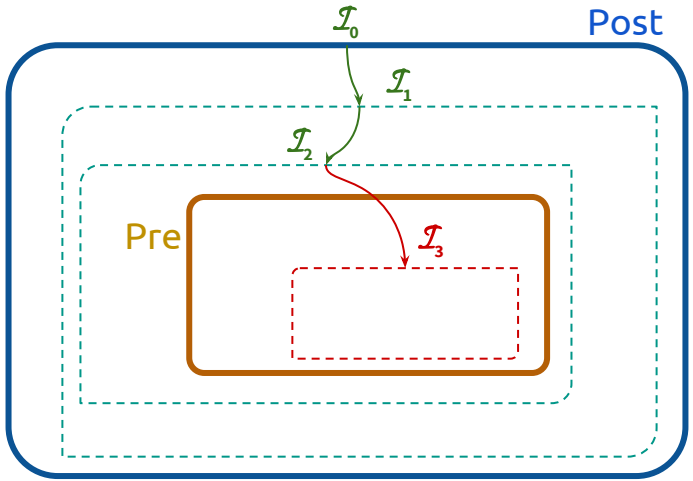


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⋮ ⋮ ⋮ ⋮

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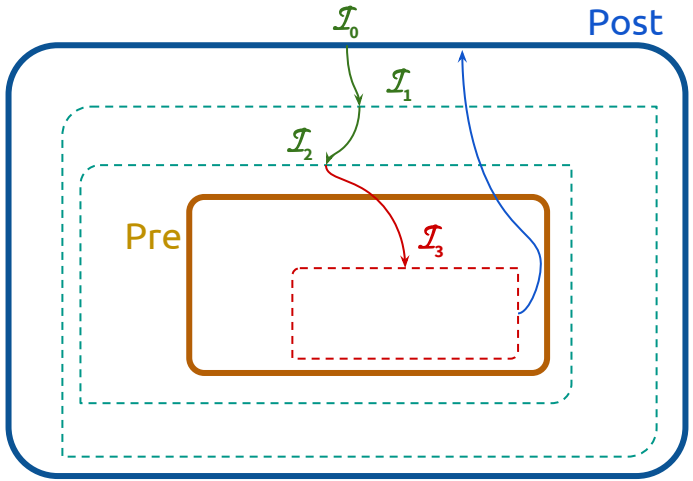
1. Start with the weakest candidate
2. Iteratively strengthen for inductiveness (by using precondition inference)
3. If the invariant is too strong, restart from (1) after augmenting the recorded states with appropriate counterexamples

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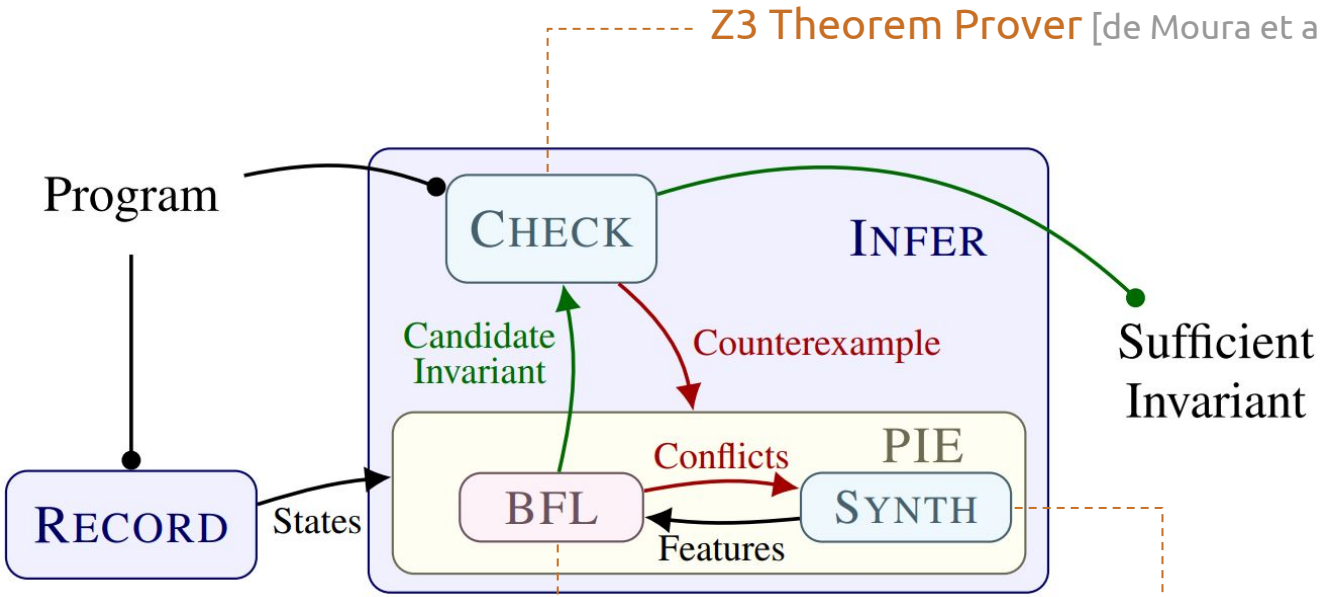
# LoopInvGen Architecture



# Thanks! ☺

Reach us at:

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