DryadSynth: A Concolic SyGuS Solver

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DryadSynth

Explicit + Symbolic search (similar to Sketch-AC)

Decision-tree representation (similar to EUSolver)

One solver for two tracks: CLIA + Invariant

Lightweight implementation based on Z3 (< 2KLOC)
Decision-Tree Representation

\[ \text{max2}(x_1, x_2) \overset{\text{def}}{=} \text{if } x_1 \geq x_2 \text{ then } x_1 \text{ else } x_2 \]

represented as coefficient vectors:
\[ (a, b, c) \overset{\text{def}}{=} ax_1 + bx_2 + c \]
Symbolic Search for Fixed Tree Height

\[ h = 2: \]

For a concrete input point:

\[ \text{max2}(5, 7) \overset{\text{def}}{=} \begin{cases} 5a_1 + 7b_1 + c_1 \geq 0 \\
\text{then } 5a_2 + 7b_2 + c_2 \\
\text{else } 5a_3 + 7b_3 + c_3 \end{cases} \]

For a set of input points \( P \), check

\[ \text{Spec}(h, P) \overset{\text{def}}{=} \bigwedge_{(u,v)\in P} \text{Spec} \left( \text{max2}(u, v), u, v \right) \]
Enumerate from Smallest Height in CEGIS

Synthesis
- solve $\text{Spec}(h, P)$ using Z3

Verification
- check $\forall u, v: \text{Spec}(f, u, v)$ using Z3

input points $P$

Succeed

Candidate implementation $f$?

fail

$h := h + 1$

height $h$

add counterexample to $P$

ok
Optimizations

Parallelization
- search heights \((1, \ldots, n)\) in parallel
- If a height has no solution, switch to the next unsearched height

Staged search for a height \(h\)
- search coefficients from \(\{0, 1, -1\}\) only
- if no solution, search coefficients between \([-C, C]\) only (\(C\) is the largest/smallest constant in Spec)
- if no solution, search all possible coefficients
Thank you!