Unification and Partial Evaluation for Component based Synthesis

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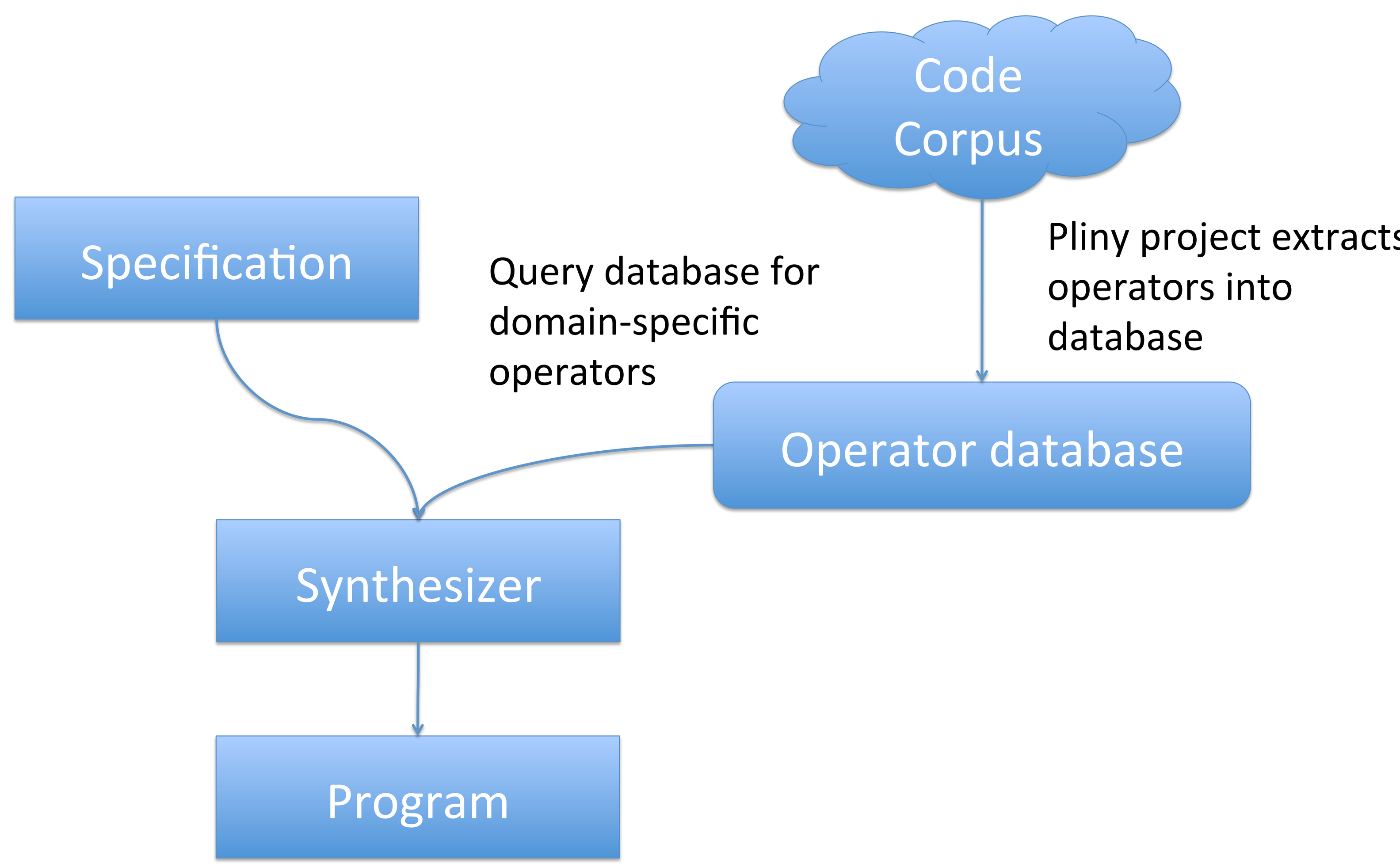
IDEA

Using operators from existing programs to perform synthesis means writing the synthesis algorithm only once and thus saves considerable time and resources.



Program specification

$$[\,] \to [\,]$$
$$[2] \to [2]$$
$$[2\ 1] \to [1\ 2]$$
$$[2\ 1\ 3] \to [3\ 1\ 2]$$

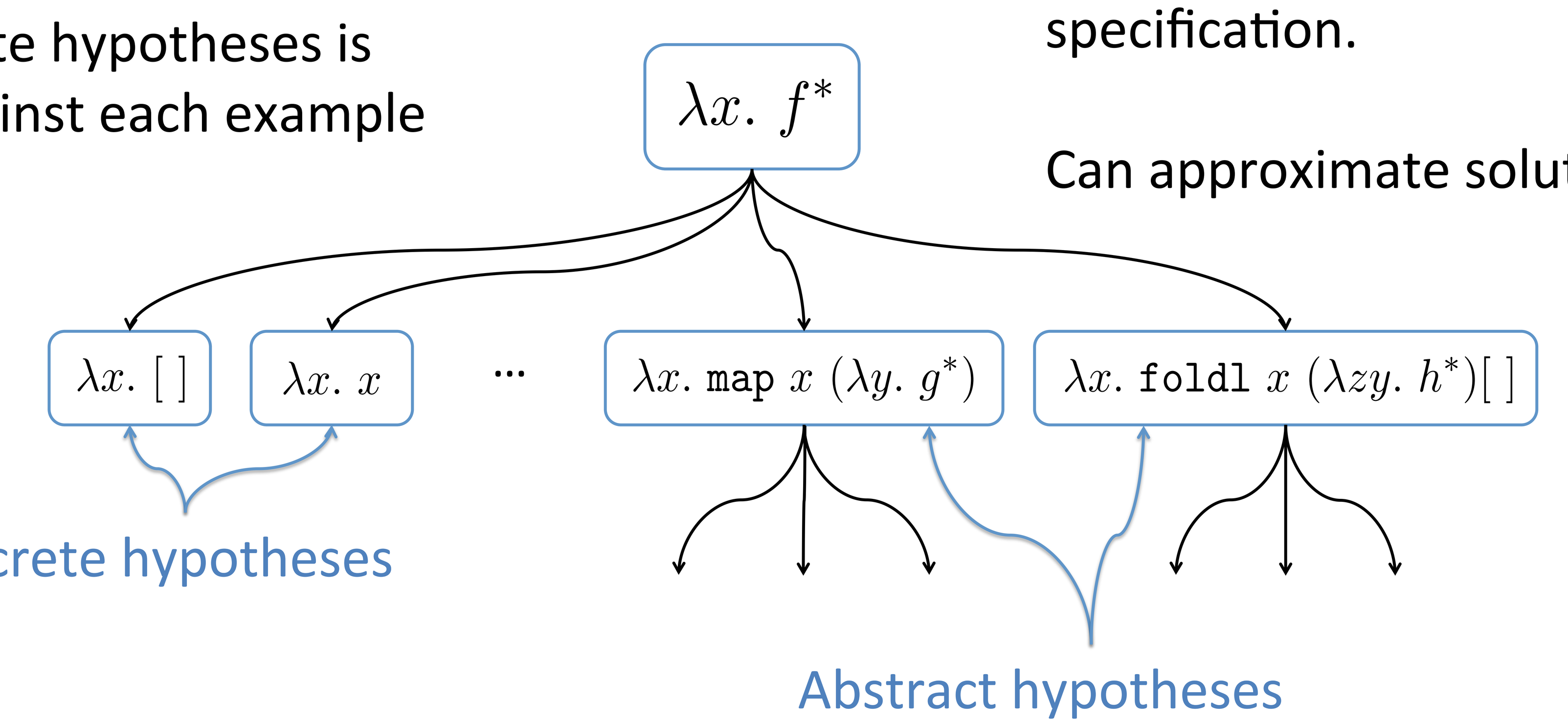
How can we prune an abstract hypothesis?

Must prove that no child can satisfy specification.

Can approximate solution using unification.

Pruning concrete hypotheses is easy: check against each example

Search tree



Child hypothesis ⟺ Assignment to holes in parent

PROBLEM

A large set of operators causes an explosion in the size of the search space.

SOLUTION

Use a new pruning technique to reduce the size of the search space, without relying on hand-coded information about operators.

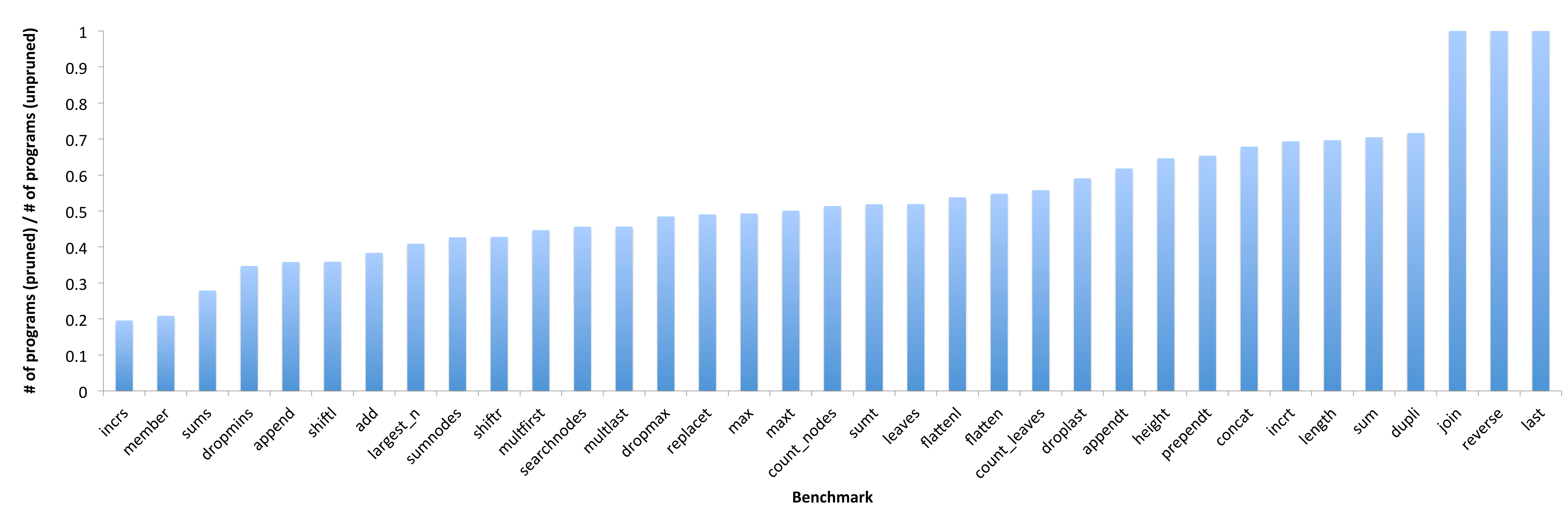
TECHNIQUE

For each abstract hypothesis H and input-output pair (i, o) determine whether there exists a substitution $\sigma = \{x_1 \leftarrow y_1 \dots x_n \leftarrow y_n\}$ such that $H[\sigma](i) = o$. In general, this is a higher-order unification problem, so is undecidable.

We can approximate the solution using partial evaluation followed by syntactic unification. For each (i, o), let H' be the result of partially evaluating $H(i)$. If H' does not unify with o, then σ does not exist. The partial evaluation step reduces the problem to first-order unification, which is efficiently decidable.

Fraction of programs remaining after pruning

46% average reduction in number of programs examined



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