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.

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 $\sigma = \{x_1 \leftarrow y_1, \ldots, x_n \leftarrow y_n\}$ 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 $\sigma$ 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