Algorithm 1: High-level Quantifier Instantiation

Input: Quantified axioms: $\forall \boldsymbol{x}.A_1, \ldots, \forall \boldsymbol{x}.A_n$
Input: Quantifier free: φ
Output: Instantiations $A_{i_1}[\boldsymbol{t_1}], \ldots, A_{i_m}[\boldsymbol{t_m}]$ s.t. $\varphi \wedge \bigwedge_j A_{i_j}[\boldsymbol{t_j}]$ is unsat
Hypothesis: $\bigwedge_j A_{i_j}[\boldsymbol{t_j}]$ is sat with a model of size ≤ 3

1 $\mathcal{M} \leftarrow \emptyset$ `// Initially, empty set of models`
2 $\mathcal{I} \leftarrow \emptyset$ `// and empty set of instantiations`
3 **while** $\varphi \wedge \mathcal{I}$ *is sat* **do**
4   Get model for $\varphi \wedge \mathcal{I}$ and add to $\mathcal{M}$
5   Find a small* set of instantiations $\mathcal{I}'$ s.t.
6   (1) $\forall M \in \mathcal{M}. \exists I \in \mathcal{I}'. M \not\models I$, and
7   (2) $\mathcal{I}'$ has a small* model
8     $\mathcal{I} \leftarrow \mathcal{I} \cup \mathcal{I}'$ *or* $\mathcal{I} \leftarrow \mathcal{I}'$
9   **if** $\varphi \wedge \mathcal{I}$ *only has large models* **then**
10   Reset $\mathcal{I} \leftarrow \emptyset$
11   **end**
12   **if** $\mathcal{M}$ *is too large and line 5 takes too long* **then**
13   Reset $\mathcal{M} \leftarrow \emptyset$ or optimize $\mathcal{M} \leftarrow \mathcal{M}'$ where $\mathcal{M}' \subset\subset \mathcal{M}$
14   **end**
15 **end**
16 **return** $\mathcal{I}$

Currently, the mechanism we think of for line 5 is by using a generalized SyGuS, but this might scale very poorly for large sets of models $\mathcal{M}$.