# Lifted delete-relaxation heuristics are competitive with their ground versions and superior to other lifted heuristics.

| Heuristics | IPC | HTG | Total |
|---|---|---|---|
| Lifted Goalcount | 597 | 382 | 979 |
| Lifted Additive + Lazy P.O. | 754 | 362 | 1116 |
| Ground additive + Lazy P.O. | 839 | 298 | 1137 |

## Relaxed Reachability and Datalog

```
(:action example
    :parameters ( ?X ?Y)
    :precondition
    (and (P ?X ?Y)
         (R ?X))
    :effect
    (and (not (P ?X ?Y))
         (Q ?X)
         (R ?Y)))
```

$$Q(X) \longleftarrow P(X, Y), R(X).$$
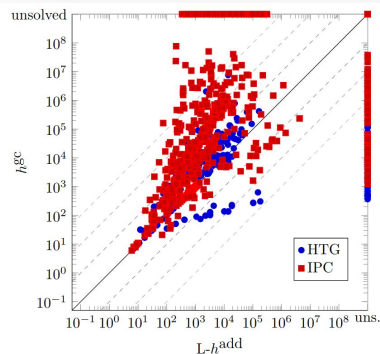$$R(Y) \longleftarrow P(X, Y), R(X).$$

## Features

- **Additive** or **max** heuristic
- **Early stopping**
- No **action predicates**
- **Lazy Search** + **Preferred operators**

Number of expansions, compared to to previous **state-of-the-art lifted planner**



## Algorithm

Computing the additive heuristic

1: $V := \text{DEFAULTHASHTABLE}(Atom, \mathbb{R}^\infty, \infty)$
2: $queue := \text{PRIORITYQUEUE}(Atom, \mathbb{R}^+)$
3: $\mathcal{M} := \emptyset$
4: **for** $fact \in \mathcal{F}$ **do**
5:     $V[fact] := 0$
6:     $queue.\text{PUSH}(fact, 0)$
7: **while not** $queue.\text{EMPTY}()$ **do**
8:     $p := queue.\text{POPMIN}()$
9:     **if** $p \notin \mathcal{M}$ **then**
10:       $\mathcal{M} := \mathcal{M} \cup \{p\}$
11:       **for** $(head \xleftarrow{w} body) \in \text{NEWRULES}(p, \mathcal{M}, \mathcal{R})$ **do**
12:         $cost := w + \sum_{q \in body} V[q]$
13:         **if** $cost < V[head]$ **then**
14:           $V[head] := cost$
15:           $queue.\text{PUSH}(head, cost)$
16: **return** $V$