Sensitivity Analysis for Saturated Post-hoc Optimization in Classical Planning

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Motivation

- cost partitioning is essential for strongest optimal planning heuristics
- two prevalent strategies:
  - recompute in every state — *expensive*
  - precompute fixed amount over sampled states — *approximation*
- new work: reuse LP solutions if provably optimal

Saturated Post-hoc Optimization Heuristic LP

$$\text{minimize} \sum_{\ell \in L} cost(\ell) \cdot Y_\ell \text{ s.t.}$$

$$\sum_{\ell \in L} mscf_h(\ell) \cdot Y_\ell \geq \boldsymbol{h(s)} \text{ for all } h \in H$$

$$Y_\ell \geq 0 \text{ for all } \ell \in L$$

Sensitivity Analysis for LPs

Analyzes a solved LP and gives perturbation ranges under which the current solution stays optimal.

Tested Variants

Condition for solving new LP:

- h^{SPhO}: always
- $h^{\text{SPhO}}_{\text{eqdist}}$: for unique $\langle h_1, \ldots, h_n \rangle$
- $h^{\text{SPhO}}_{\text{grouped}}$: for unique grouped $\langle h_1, \ldots, h_n \rangle$
- $h^{\text{SPhO}}_{\text{range}}$: if range based SA not applicable
- $h^{\text{SPhO}}_{100\%}$: if 100% Rule based SA not applicable

Conclusions

- up to 6 orders of magnitude fewer LP solver calls
- speed-up by up to 100x

Future Work

- apply to other cost partitioning heuristics
- theoretical insights from interpreting Sensitivity Analyses

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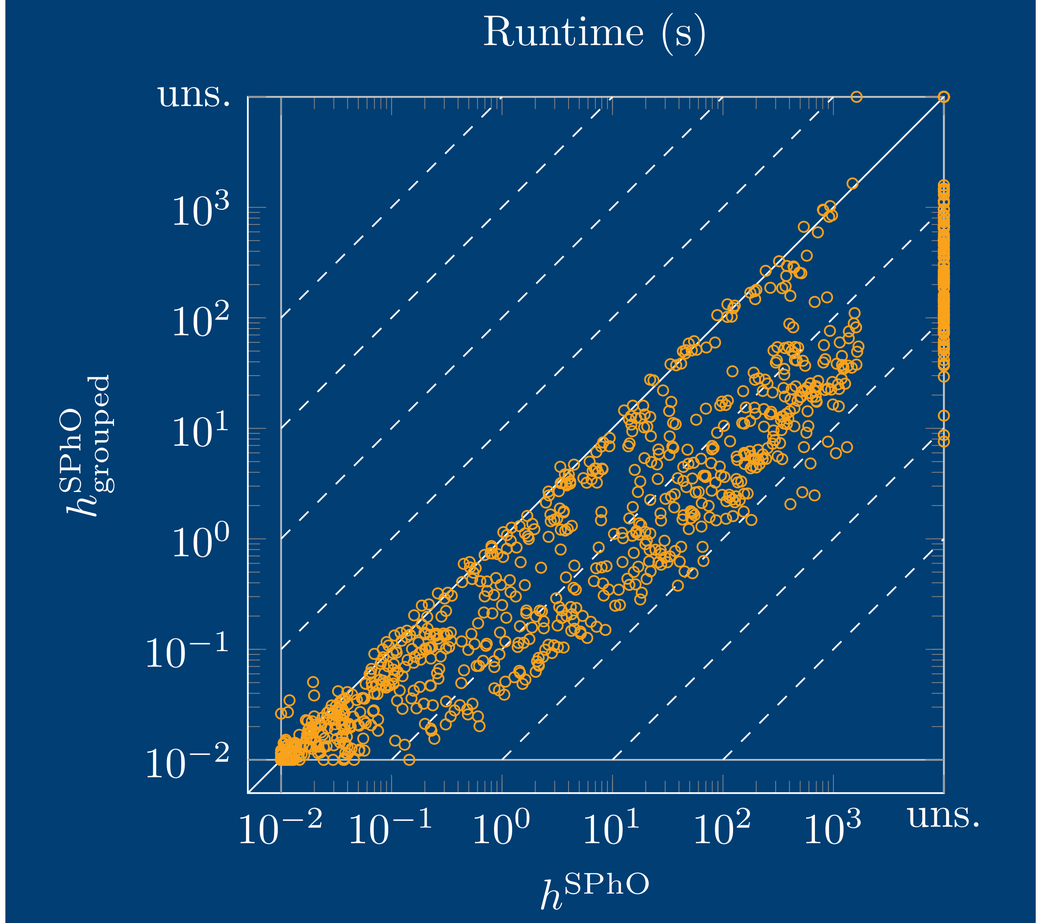
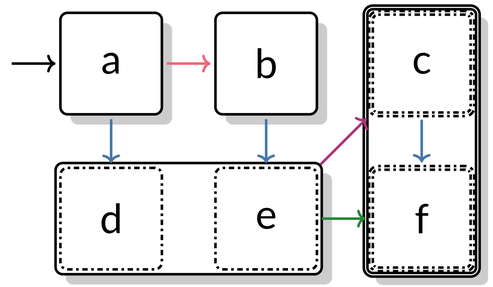
Speeding up optimal planning with LP Sensitivity Analysis

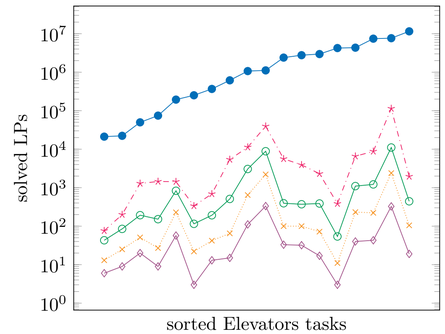


Abstraction Heuristics



Cost Partitioning

Distribute action costs $cost(a)$ between n heuristics such that:
$\sum_{i=1}^{n} cost_i(a) \leq cost(a)$



Solved LPs