Principles of AI Planning

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Exercise Sheet 10
Due: Friday, January 17th, 2020

Send your solution to `mario.kantz@gmail.com` (PDF only) or submit a hardcopy before the lecture. The exercise sheets may and should be worked on and handed in in groups of two or three students. Please indicate all names on your solution.

Exercise 10.1 (Affecting labels vs. orthogonality, 4 points)

Recall: For a transition system $\mathcal{A}$ and a label ℓ of $\mathcal{A}$, we say that ℓ *affects* $\mathcal{A}$ if $\mathcal{A}$ has a transition $\langle s, \ell, t \rangle$ with $s \neq t$.
Prove the following: Let $\mathcal{A}_i$ be an abstraction of some transition system $\mathcal{T}$ with abstraction mapping α_i for $i \in \{1, 2\}$. If no label of $\mathcal{T}$ affects both $\mathcal{A}_1$ and $\mathcal{A}_2$, then α_1 and α_2 are orthogonal.

Exercise 10.2 (Potential heuristics: consistency constraints, 6 points)

Let $\Pi = \langle V, I, O, \gamma \rangle$ be an SAS$^+$ planning task in transition normal form, and let $\mathcal{F} = \{f_{v=d} \mid v \in V, d \in \mathcal{D}_v\}$ be the set of all atomic features over Π. Finally, let

$$h(s) = \sum_{\text{fact } v=d} w_{v=d} \cdot f_{v=d}(s)$$

be the potential heuristic with potentials $w_{v=d}$ for all $v \in V$, $d \in \mathcal{D}_v$, such that for all $o \in O$, the following constraint is satisfied:

$$\sum_{\text{fact } v=d \text{ consumed by } o} w_{v=d} - \sum_{\text{fact } v=d \text{ produced by } o} w_{v=d} \leq cost(o) \ .$$

Prove: Then h is consistent, i.e., $h(s) - h(t) \leq cost(o)$ for all transitions (s, o, t) in $\mathcal{T}(\Pi)$.