Principles of AI Planning

Prof. Dr. B. Nebel, Dr. R. Mattmüller
D. Drexler
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University of Freiburg
Department of Computer Science

Exercise Sheet 7

Due: Friday, December 8th, 2017

Exercise 7.1 (Abstraction heuristics, 5+5 points)

A state of a 15-puzzle planning task is given as a permutation $\langle b, t_1, \ldots, t_{15} \rangle$ of $\{1, \ldots, 16\}$, where b denotes the empty tile (blank) and all other components denote the positions of the tiles.
Let $T^1 = \{t^1_1, \ldots, t^1_n\}, T^2 = \{t^2_1, \ldots, t^2_m\}$ with $1 \leq n, m \leq 14$ be a partitioning of $\{t_1, \ldots, t_{15}\}$ (i.e., $T^1 \cup T^2 = \{t_1, \ldots, t_{15}\}$ and $T^1 \cap T^2 = \emptyset$). Consider the following abstractions:

- $\alpha_1(\langle b, t_1, \ldots, t_{15} \rangle) = \langle b, t^1_1, \ldots, t^1_m \rangle$
- $\alpha_2(\langle b, t_1, \ldots, t_{15} \rangle) = \langle b, t^2_1, \ldots, t^2_n \rangle$
- $\alpha_3(\langle b, t_1, \ldots, t_{15} \rangle) = \langle t^1_1, \ldots, t^1_m \rangle$
- $\alpha_4(\langle b, t_1, \ldots, t_{15} \rangle) = \langle t^2_1, \ldots, t^2_n \rangle$

For $1 \leq i \leq 4$, the heuristic estimates of h_i are equal to lengths of optimal plans in the respective abstractions (e.g., $h_i(s) = h^*(\alpha_i(s))$). Show that:

(a) $h_1 + h_2$ is not admissible.

(b) $h_3 + h_4$ is admissible.

Hint: A heuristic is admissible if it is goal-aware and consistent.

You may and should solve the exercise sheets in groups of two. Please state both names on your solution.