Principles of AI Planning

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Exercise Sheet 6

Due: December 13th, 2011

Exercise 6.1 (Stability of h_{add}, 3 points)

Show that it is important to test for stability when computing h_{add} by giving an example where you get an unnecessarily high overestimation when not performing this test.

Hint: The solution to this exercise is a planning task and its relaxed planning graph where h_{add} is higher in the goal node in layer k than in the goal node of layer $j > k$.

Exercise 6.2 (Relaxed planning graph and heuristics (part 2), 1.5+1.5 points)

Consider the relaxed planning task Π^+ (from exercise 5.2) with variables $A = \{a, b, c, d, e\}$, operators $O = \{o_1, o_2\}$, $o_1 = \langle a \vee b, c \wedge d \wedge (c \rhd b)\rangle$, $o_2 = \langle d, e\rangle$, goal $\gamma = b \wedge e$ and initial state $s = \{a \mapsto 1, b \mapsto 0, c \mapsto 0, d \mapsto 0, e \mapsto 0\}$. Solve the following exercises by drawing the relaxed planning graph for the lowest depth k that is necessary to extract a solution.

(a) Calculate $h_{\text{sa}}(s)$ for Π^+.

(b) Calculate $h_{\text{FF}}(s)$ for Π^+.

Exercise 6.3 (Heuristics, 1+1+1+1 points)

Prove the following inequalities. You may use the fact that h^+ is equal to the cost of the cheapest solution graph (i.e. to the cost of an optimal relaxed plan).

(a) $h_{\max} \leq h^+$

(b) $h^+ \leq h_{\text{add}}$

(c) $h^+ \leq h_{\text{FF}}$

(d) $h^+ \leq h_{\text{sa}}$

Note: The exercise sheets may and should be worked on in groups of two students. Please state both names on your solution (this also holds for submissions by e-mail).