Principles of AI Planning

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Winter Semester 2013/2014

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Exercise Sheet 9

Due: Friday, January 17th, 2014

Exercise 9.1 (LM-cut heuristic, 5 points)

Consider the STRIPS planning task specified by $\Pi = \langle A, I, O, \gamma \rangle$, where

$$
\begin{aligned}
A &= \{s, b, c, d, e, t\} \\
I &= \{s \mapsto 1, b \mapsto 0, c \mapsto 0, d \mapsto 0, e \mapsto 0, t \mapsto 0\} \\
O &= \{o_i \mid 1 \leq i \leq 6\} \\
o_1 &= \langle s, b \wedge c \rangle \\
o_2 &= \langle b, d \rangle \\
o_3 &= \langle c, e \rangle \\
o_4 &= \langle d \wedge e, t \rangle \\
o_5 &= \langle c \wedge e, t \rangle \\
o_6 &= \langle e, s \rangle \\
\gamma &= t
\end{aligned}
$$

Compute $h_{\text{LM-cut}}(I)$. In each iteration i of the algorithm (except for the last iteration where you identify $h^{c_i}_{\max}(t) = 0$), give the respective **pcf** D_i, the corresponding **justification graph** G_i of D_i, the **sets** V_i^*, V_i^0, V_i^b and L_i as well as the (intermediate) **heuristic value**.
Contrary to the lecture, please break pcf ties by choosing the **alphabetically largest** proposition (this ensures a unique solution).

Hints: When constructing an s-t-cut, please keep the definition in mind (simply drawing a line through the graph may yield wrong results). Furthermore, a justification graph can contain multiple edges as well as cycles, although the example in the lecture did not.

Exercise 9.2 (Active operators and projections, 2+3 points)

Let $\Pi = \langle V, O, I, \gamma \rangle$ be a SAS+ planning task and let s be a state. Show that the set of active operators $Act(s) \subseteq O$ in s can be identified efficiently by considering paths in the projection of Π onto v:

(a) Establish and prove a connection between the projection of Π onto v and the domain transition graph of v.

(b) Specify an efficient algorithm for the identification of $Act(s)$, prove its soundness and completeness, and reason about the runtime of the algorithm in terms of the input size.

You can and should solve the exercise sheets in groups of two. You can send your solution to `ortlieb@informatik.uni-freiburg.de`. Please give both your names on your solution.