Principles of AI Planning

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Exercise Sheet 12 Due: Friday, January 25th, 2019

Send your solution to drexlerd@tf.uni-freiburg.de or submit a hardcopy before the lecture.

Exercise 12.1 (Weak and strong preimages, 2 points)

Let $\mathcal{T} = \langle S, O, T, s_0, S_\star \rangle$ be a (nondeterministic) transition system that happens to be deterministic, i.e., for each state $s \in S$ and each label $o \in O$, there exists at most one state $s' \in S$ such that $\langle s, o, s' \rangle \in T$.

Show that for all operators $o \in O$ and all state sets $S' \subseteq S$, where $\operatorname{spreimg}_{o}(S') = \operatorname{spreimg}_{o}(S')$.

Exercise 12.2 (Dynamic programming, 4 points)

Consider the propositional nondeterministic planning task $\Pi' = \langle A', I', O', \gamma' \rangle$, with

- the set of variables $A' = \{a, b, c\},\$
- initial state $I' = \{a \mapsto 0, b \mapsto 0, c \mapsto 1\},\$
- set of operators $O' = \langle o_1, o_2, o_3 \rangle$, where

$$- o_1 = \langle a, \{b \land c, b \land \neg c\} \rangle, \\ - o_2 = \langle \neg a \land b, \{a \land \neg b, a\} \rangle, \\ - o_3 = \langle \neg b, \{\neg a \land b\} \rangle$$

• and goal $\gamma' = a \wedge b$

Determine a strong plan for Π' by computing backward distances with the dynamic programming algorithm.

Exercise 12.3 (Nondeterministic modeling, 3+1 points)

- (a) Model the game *Tic-Tac-Toe* as a nondeterministic planning task for a grid of size 2×2 with the goal to get two markers in a row, column or diagonally. Formalize the game from the first player's perspective. See http://en.wikipedia.org/wiki/Tic-tac-toe if you have questions about the rules of the game.
- (b) Determine and report a strong plan for this planning task.