Principles of AI Planning

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

Exercise Sheet 12

Due: Friday, February 3rd, 2017

Exercise 12.1 (Dynamic programming, 3 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
  - $o_1 = \langle a, \{b \wedge c, b \wedge \neg c\} \rangle$,
  - $o_2 = \langle \neg a \wedge b, \{a \wedge \neg b, a\} \rangle$,
  - $o_3 = \langle \neg b, \{\neg a \wedge b\} \rangle$
- and goal $\gamma' = a \wedge b$

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

Exercise 12.2 (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 $S' \subseteq S$, $\text{wpreimg}_o(S') = \text{spreimg}_o(S')$.

Exercise 12.3 (Nondeterministic progression search, 3 + 2 points)

(a) Model the game *Tic-Tac-Toe* as a nondeterministic planning task for a grid of size $\mathbf{2} \times \mathbf{2}$ 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 a strong plan for this planning task as a graph by providing a solution graph generated by progression search.

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