Principles of AI Planning

Prof. Dr. B. Nebel, Dr. R. Mattmüller
D. Speck
Winter Semester 2016/2017

University of Freiburg
Department of Computer Science

Exercise Sheet 3

Due: Friday, November 11th, 2016

Exercise 3.1 (Example for STRIPS regression, 4 points)

Consider the STRIPS planning task with atoms $A = \{a, b, c, d, e\}$, initial state $I = \{a \mapsto 0, b \mapsto 1, c \mapsto 0, d \mapsto 1, e \mapsto 1\}$, goal $\gamma = a \wedge d$, and operators $O = \{o_1, o_2, o_3\}$, where

$$o_1 = \langle b \wedge d, c \wedge e \wedge \neg d \rangle$$
$$o_2 = \langle b, a \wedge \neg c \wedge \neg d \rangle$$
$$o_3 = \langle a, d \rangle.$$

Solve this problem with a *breadth-first search* (BFS) using the STRIPS regression method. Submit the search tree that you obtain and record the solution plan. Do not expand a node further if the formula at that node is unsatisfiable or represents a set of states that is a (strict or nonstrict) subset of the set of states represented by the formula at a previously expanded node. Specify the result of regression for each node of the BFS tree.

Exercise 3.2 (Example for general regression, 6 points)

Consider the following situation: Romeo and Juliet are at home.

$$I(p) = 1 \text{ iff } p \in \{\textit{romeo-at-home}, \textit{juliet-at-home}\}$$

Juliet wants to go dancing, but Romeo wants to stay at home.

$$\gamma = \textit{juliet-dancing} \wedge \textit{romeo-at-home}$$

Since this is a real couple, Romeo can't just say that he doesn't want to go dancing – if Juliet goes dancing and he is at home, he has to join her. This is modelled by the following operator:

$$\begin{aligned}\textit{go-dancing} = \langle & \textit{juliet-at-home}, \\ & \textit{juliet-dancing} \wedge \neg \textit{juliet-at-home} \wedge \\ & (\textit{romeo-at-home} \rhd (\textit{romeo-dancing} \wedge \neg \textit{romeo-at-home}))\rangle\end{aligned}$$

Of course, Romeo can always pretend he has work to do:

$$\textit{go-work} = \langle \textit{romeo-at-home}, \textit{romeo-at-work} \wedge \neg \textit{romeo-at-home} \rangle$$

Since he would not want to stay at work forever, we must also model the inverse operator:

$$\textit{go-home} = \langle \textit{romeo-at-work}, \textit{romeo-at-home} \wedge \neg \textit{romeo-at-work} \rangle$$

We thus obtain the planning problem

$$\begin{aligned}\langle & \{\textit{romeo-at-home}, \textit{romeo-dancing}, \textit{romeo-at-work}, \\ & \textit{juliet-at-home}, \textit{juliet-dancing}\}, \\ & I, \{\textit{go-dancing}, \textit{go-work}, \textit{go-home}\}, \gamma\rangle\end{aligned}$$

Solve this problem with regression *breadth-first search* (BFS) without splitting. Submit the search tree that you obtain and record the solution plan. At every node of the search tree, simplify the state formula as much as possible and do not expand the node further if the formula at that node is unsatisfiable or identical to the formula at a previously expanded node. During expansion, use the operator ordering *go-work*, *go-home*, *go-dancing*. Specify the result of regression for each node of the BFS tree.

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