Principles of AI Planning

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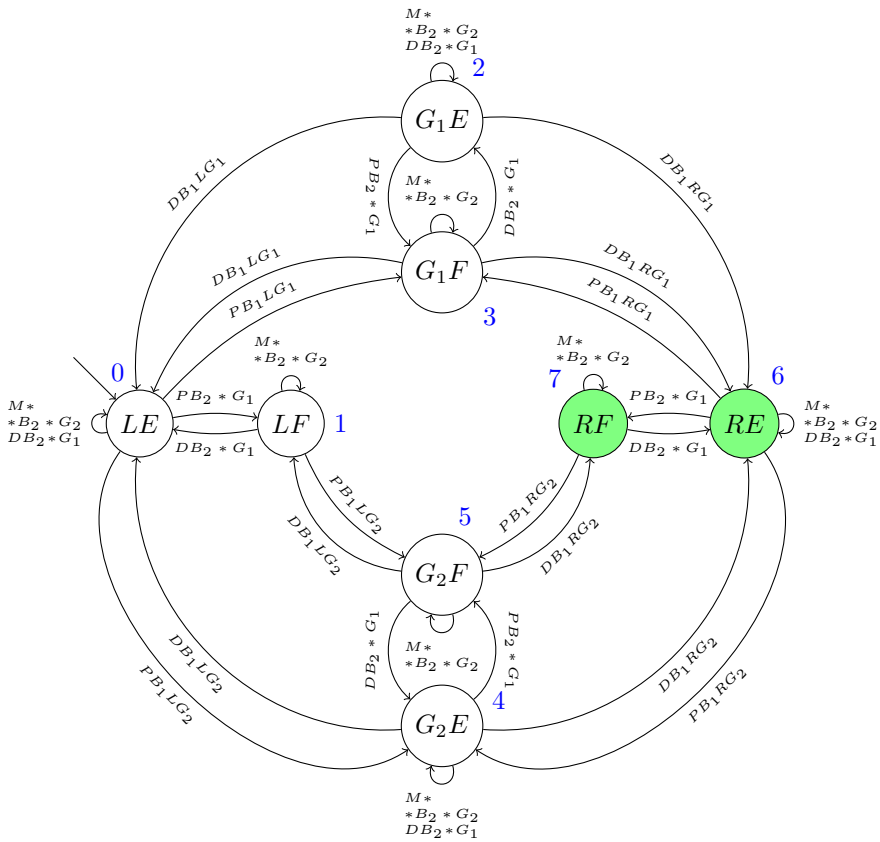
Exercise Sheet 10

Due: January 25th, 2013

Exercise 10.1 (Merge-and-Shrink abstractions, 2 + 3 points)

Consider the (SAS$^+$) Gripper planning task Π from Exercise Sheet 9. The graph for $T^{\pi^{\{pos_{B_1}\}}} \otimes T^{\pi^{\{status_{G_1}\}}}$ and its two-dimensional table are given by



$T^1_{m\&s}$	$s_2 = 0$	$s_2 = 1$
$s_1 = 0$	0	1
$s_1 = 1$	2	3
$s_1 = 2$	4	5
$s_1 = 3$	6	7

The corresponding one-dimensional tables are given by

T_{B_1}	L	G_1	G_2	R
	0	1	2	3

T_{G_1}	E	F
	0	1

(a) Shrink the graph by collapsing all nodes with identical g and h values. Use linked lists to renumber the nodes. Visualize the resulting graph, and specify the resulting new two-dimensional table and the final status of the linked list.

(b) Which heuristic value do we get for $s = \{pos_{B_1} \mapsto L, pos_{B_2} \mapsto G_1, pos_{Robby} \mapsto R, status_{G_1} \mapsto F, status_{G_2} \mapsto E\}$ and how is the look-up of the value performed?

Exercise 10.2 (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 10.3 (Symbolic regression search with boolean function operations, 2 points)

Consider the planning task Π' from **Exercise 10.2**. Perform a regression search with boolean function operations and simplify all formulas as much as possible. It is sufficient to calculate $spreimg_o(\alpha)$, where o is the operator from the strong plan of Exercise 10.2 that is applied in a state described by $spreimg_o(\alpha)$ and results in a state described by α.

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).