Foundations of Artificial Intelligence

Prof. Dr. B. Nebel, Prof. Dr. W. Burgard — University of Freiburg
Dr. A. Kleiner, R. Mattmüller — Department of Computer Science
Summer Term 2008

Exercise Sheet 9

Due: Friday, July 4, 2008

Exercise 9.1 (POP algorithm)

Consider a planning problem with initial state $\{x\}$ and goal $\{y, z\}$ as well as the actions $a_1 = \langle\{x\}, \{\neg x, y\}\rangle$, $a_2 = \langle\{x\}, \{\neg x, z\}\rangle$, and $a_3 = \langle\emptyset, \{x\}\rangle$, where the first components of the tuples always denote the preconditions and the second components denote the effects.
Sketch a complete and consistent plan including all temporal and causal links as it would be computed by the POP algorithm.

Exercise 9.2 (Planning Graphs)

Solve the problem from the previous exercise using a planning graph. Draw all mutex relations.

Exercise 9.3 (Heuristic Search Planning I)

(a) Give the *relaxed* planning problem which you obtain by ignoring the negative operator effects in the problem from the previous exercises.
(b) Which heuristic value do you get in the initial state $\{x\}$ if you compute the heuristic distance for each atom separately, assuming independence of sub-goals, using the planning-graph approach on the relaxed problem, and summing up the values for the different atoms?

Exercise 9.4 (Heuristic Search Planning II)

Assume that we do not only allow conjunctions of positive literals as operator preconditions, but arbitrary propositional formulae without negation symbols. Show that ignoring negative effects can never lead to a situation where a precondition appears to be violated although it is actually satisfied, more precisely: Let s, s' be sets of facts and χ a propositional formula over the facts which does not contain negation symbols.
Show that if $s \models \chi$ and $s \subseteq s'$, then $s' \models \chi$.
Hint: Structural induction over χ. For atomic facts a we have $s \models a$ iff $a \in s$, and the inductive cases $\vee$ and $\wedge$ are defined as usual.

The exercise sheets may and should be worked on in groups of three (3) students. Please fill the cover sheet[1] and attach it to your solution.

[1] http://www.informatik.uni-freiburg.de/~ki/teaching/ss08/gki/coverSheet-english.pdf