Foundations of Artificial Intelligence

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Exercise Sheet 2

Due: Friday, May 4, 2007

Exercise 2.1 (Modeling)

Formalize the following problems by providing descriptions of the state space, initial state, goal test, operators, and a path cost function, in a way similar to the formalization of the missionaries and cannibals problem from the lecture.

(a) You drive a delivery truck and have to transport packages from different depots to their respective goal locations within a town.
(b) You wish to solve *Rubik's Cube* (`http://en.wikipedia.org/wiki/Rubik%27s_Cube`).
(c) You have lost your way in a small town and have to find a pharmacy. You have got no street map and there is no one around to ask for the way.

Exercise 2.2 (Searching under Unobservability and Nondeterminism)

Consider the sensorless two-location vacuum cleaner world from the lecture for the case in which the cleaning action can nondeterministically soil the current location if it was already clean.
Draw the belief space reachable from the initial belief state in which the robot considers all world states possible. Explain why the problem of cleaning both locations with certainty is unsolvable in this case.

Exercise 2.3 (Search Algorithms)

Prove each of the following statements:

(a) Breadth-first search is a special case of uniform-cost search.
(b) Breadth-first search, depth-first search, and uniform-cost search are special cases of greedy best-first search.
(c) Uniform-cost search is a special case of A* search.

Exercise 2.4 (A* Search)

Consider the following 8-puzzle instance:

Initial state:

2	8	3
1	6	4
7		5

Goal state:

1	2	3
8		4
7	6	5

Solve the problem using the A* algorithm together with the Manhattan distance heuristic, i.e. the heuristic based on the sum of horizontal and vertical distances of all tiles from their goal positions. Show the search tree.

The exercise sheets may and should be worked on in groups of three (3) students. Please write all your names and the number of your exercise group on your solution.