

A.I. Assignment II - Documentation

Vlad Vasilescu

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Problem 1 - Water Jug Problem

Given a number of jugs without any measuring markings of specified quantities and an infinite water source, find a way to get to the asked for quantities in each jug.

The "WaterJugProblem" class:

Implements the "Problem" class. Apart from the two constructor arguments of it's parent class (initial state and goal state) it also requires a third, the maximum quantity for each jug.

Possible actions:

- Fill a jug.
- Pour out the water from a jug.
- Pour water from one jug to another.

Heuristic:

The sum of differences between the goal and current quantity for each jug.

Conclusion:

Even with a simple heuristic the informed search performs much better than the uninformed one (roughly 100 times faster on the given example).

Problem 2 - N-Puzzle Problem

Given a board of $N \times N$ size with $N^2 - 1$ numbered tiles and a missing one, find a way to get to the given arrangement of the tiles.

The "NPuzzleProblem" class:

Implements the "Problem" class. It's constructor also requires a third argument, the board size.

Possible actions:

- Swap the empty tile with the one above it. (Not possible if the empty tile is on the first row)
- Swap the empty tile with the one below it. (Not possible if the empty tile is on the last row)
- Swap the empty tile with the one to it's left. (Not possible if the empty tile is on the first column)
- Swap the empty tile with the one to it's right. (Not possible if the empty tile is on the last column)

Heuristics:

1. Number of tiles not on their row plus number of tiles not on their column.
2. $h = P + N * S$ where:
 - P is manhattan distance of each tile to it's proper position.
 - N is the number of lines/columns on the board.
 - S is a score calculated by iterating through each line and adding 2 for every tile that is not followed by it's proper successor and 0 otherwise. The score starts at one.

This heuristic is based upon "Nilsson's Sequence Score".

Conclusion:

While the first heuristic is much simpler, it is also faster (approx. 5-10 times) than the second. Even so the difference between using any of the heuristics and an uninformed search is much greater. I haven't included the uninformed search test for this problem because it would increase the run time from under one second to a good couple of seconds.

Another thing we can observe is that while both the heuristics lead to the same result (the goal state) they take different action paths.

Final note:

The testing methodology used is measuring the time right before and after each search and calculating the difference.