COMP 472: Artificial Intelligence
State Space Representation and Uninformed Search

1 Question

Consider the following problem:

Once upon a time a farmer went to the market and purchased a fox, a goose, and a bag of beans. On his way home, the farmer came to the bank of a river and rented a boat. But in crossing the river by boat, the farmer could carry only himself and a single one of his purchases - the fox, the goose, or the bag of the beans.

If left alone, the fox would eat the goose, and the goose would eat the beans. The farmer's challenge was to carry himself and his purchases to the far bank of the river, leaving each purchase intact.

Represent this problem as a search problem. Choose a representation for the problem's states and:

(a) Write down the initial state.

(b) Write down the goal state.

(c) Write down all illegal states.

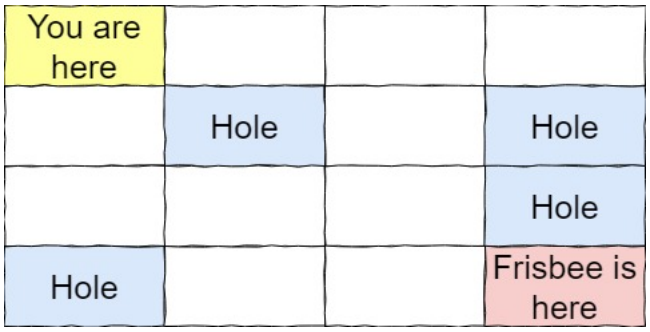
(d) Write down the possible actions.

(e) Draw the state space for this problem.

(f) Find a sequence of moves to solve this problem.

2 Question

Exercise from OpenAI[1]*:* Winter is here. You and your friends were tossing around a Frisbee at the park when you made a wild throw that left the Frisbee out in the middle of the lake. The water is mostly frozen, but there are a few holes where the ice has melted. If you step into one of those holes you'll fall into the freezing water. At this time, there's an international Frisbee shortage, so it's absolutely imperative that you navigate across the lake and retrieve the disc as soon as you can. The surface is described using a rectangular grid like the figure below:



(a) Let a 4×4 matrix represent the above grid. The position of each cell in the grid can then be represented by the indices of the elements of the matrix. Given this representation, write down the initial state and the goal states.

(b) Assume that the possible actions in a grid world are moving left, right, up, and down. Since we would like to reach the goal state as soon as possible (i.e. minimizing the number of actions), then we can assign a constant uniform cost for each action, for example a cost of 1.
Draw the state space for this problem.

Tree with possibilities

(c) Find a sequence of moves to solve this problem.

(d) Perform a Breadth-First Search on this state space. At each step, indicate the content of the OPEN and CLOSED lists.

(e) Perform a Depth-First Search on this state space. At each step, indicate the content of the OPEN and CLOSED lists.

(f) Perform a Uniform Cost Search on this state space. At each step, indicate the content of the OPEN and CLOSED lists.

[1] `https://gym.openai.com/envs/FrozenLake-v0/`