COMP 6721 Applied Artificial Intelligence (Fall 2021)

Lab Exercise #2: State Space Search

Question 1 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

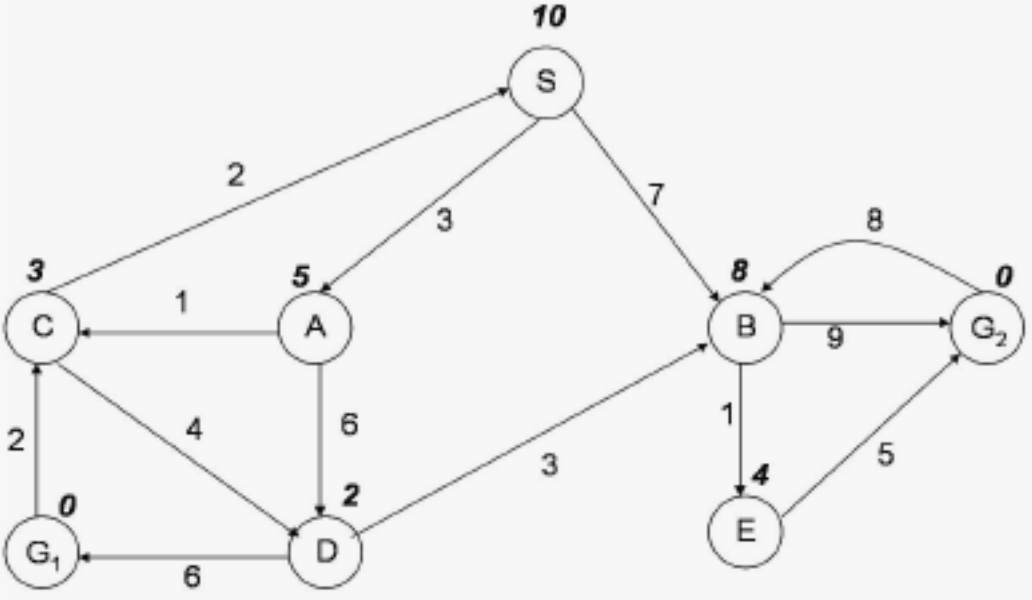
(c) Write down all illegal states

(d) Write down the possible actions

(e) Draw the state space for this problem

(f) Find a series of moves to solve this problem

Question 2 Assume that S is the initial state and G_1 and G_2 are the goal states. The possible actions between states are indicated by arrows. The number labelling each arc is the actual cost of the action. For example, the cost of going from S to A is 3. The number in bold italic near each state is the value of the heuristic function h at that state. For example, the value of h at state C is 3. When all else is equal, expand states in alphabetical order.



For the following search strategies, show the states visited, along with the open and closed lists at each step (where it applies).

(a) Breadth-first search

(b) Depth-first search

(c) Iterative deepening depth-first search

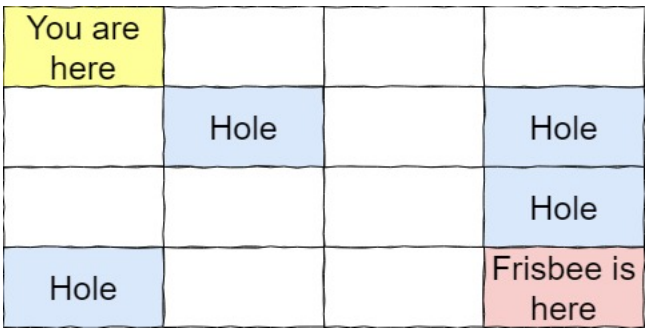
(d) Uniform cost search

(e) Hill climbing

(f) Best-first search

(g) Algorithm A

Question 3 *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) What are the initial and goal state?

(b) What are the illegal states?

(c) What are the possible actions and what should be their costs?

(d) Draw the state space for this problem.

(e) Find a series of moves to solve this problem.

(f) Perform the following search strategies, show the states visited, along with the open and closed lists at each step.

I Breadth-first search

II Uniform cost search

III Depth-first search

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