Homework 1 – Search and Problem Solving

Problem 1

An agent has at disposal two pitchers (P_3 and P_5) that can contain exactly 3 and 5 L of liquid, respectively. The pitchers are initially empty (initial state). The goal is to have exactly 4 L in P_5 (goal state). To achieve this objective, the agent can take the following actions:

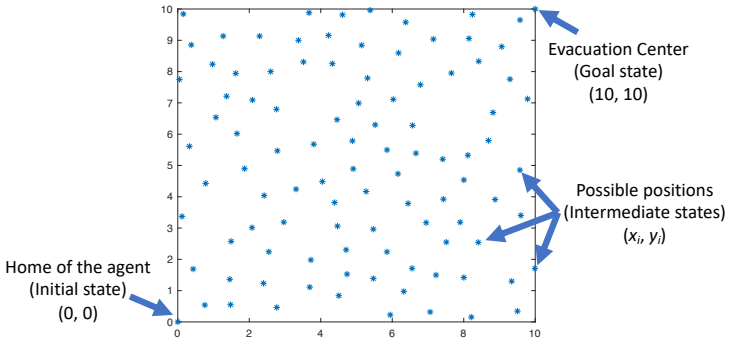
1) *Fill P_3 with water from the tap.* In this case, the agent can only FULLY fill the pitcher (it CANNOT partially fill the pitcher from the tap). Note that P_5 is too big to fit under the tap and, hence, CANNOT be filled with water from the tap.
2) *Pour the content of P_3 into P_5.* In this case, the agent must FULLY pour the liquid content of P_3 into P_5, unless P_5 becomes full during this process. If P_5 becomes full, the agent must stop and some liquid will remain in P_3.
3) *Pour the content of P_5 into P_3.* In this case, the agent must FULLY pour the liquid content of P_5 into P_3, unless P_3 becomes full during this process. If P_3 becomes full, the agent must stop and some liquid will remain in P_5.
4) *Empty the liquid content of P_3.* In this case, the agent must FULLY empty P_3 (the pitcher cannot be partially emptied).
5) *Empty the liquid content of P_5.* In this case, the agent must FULLY empty P_5 (the pitcher cannot be partially emptied).

Implement a breadth-first and depth-first search algorithm to identify a sequence of actions allowing the agent to reach the goal state. Compare the numbers of actions given by these two algorithms and conclude.

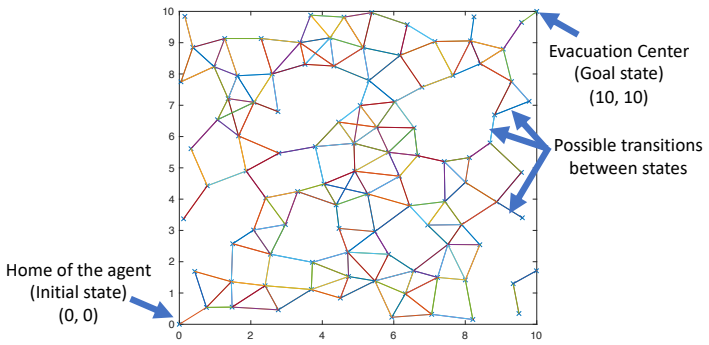
Bonus: Implement an informed search using the algorithm of your choice.

Problem 2

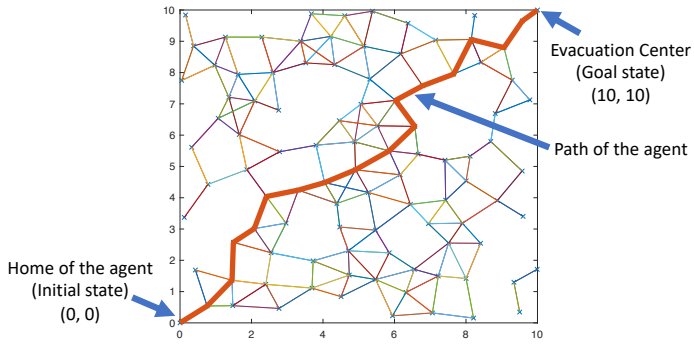
In case of a wildfire, an agent would be expected to evacuate its home (initial state I) and reach the evacuation center (goal state G). Your goal is to model the path that the agent is likely to take to go from I to G so as to optimize the evacuation plan. The home of the agent is located at the position (0, 0) in a (x, y) Cartesian plane, while the evacuation center is located at (10, 10). To achieve its goal, the agent can move from one position to another (actions). The agent can only visit 98 possible intermediate positions (i.e., possible intermediate states, see example below) located at (x_i, y_i), which are given in the attached Excel sheet.



Starting from a given position/state M_i (x_i, y_i), the agent can ONLY move to the neighboring positions/states M_j (x_j, y_j) that are close enough, namely, if the distance M_iM_j between these two states is strictly lower than 1.3 (see example below).



By coding a greedy search algorithm, determine the path (sequence of states and actions) of the agent to go from I to G. Plot this path (see below) and determine the number of actions of the agent.



Bonus: Check if the path determined by the greedy search algorithm is the optimal one (shortest one) in terms of (i) number of actions and (ii) total traveled distance.