Artificial Intelligence: Programming 1 (P1)
A* Search

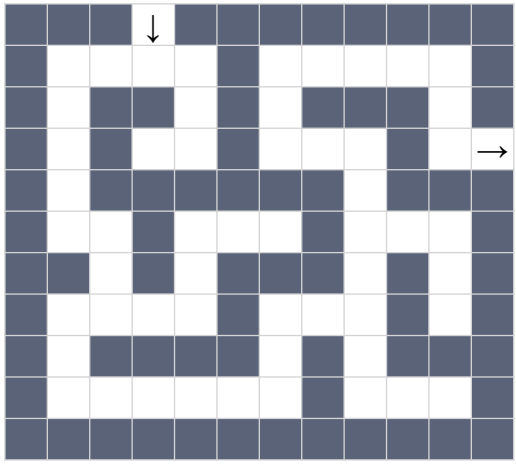
Instructor: Dr. Shengquan Wang

Due Time: 10PM, 09/24/2023

In this programming assignment, we aim to implement the A* search algorithm.

1 Instructions

We consider a maze under a windy condition as shown in the following figure. The entrance and the



exit are at the top-left and bottom-right, respectively. We assume that the wind comes from the *north* and the cost of one step for the agent is defined as follows: 1 for moving along the wind direction; 3 for moving against the wind direction; 2 for moving with the side wind direction. The two arrows indicate the entrance and the exit. All dark-shaded squares are obstacles.

We use a modified Manhattan distance used in class as the heuristic function $h(n)$ by considering the windy situation. For example, for the entrance node, the agent has to move at least 8 steps eastward and 3 steps southward in order to reach the exit. Therefore, we have $h(n) = 2 * 8 + 1 * 3 = 19$ at the entrance node.

We use a label we did in class to indicates the order of choosing the corresponding unlabeled square and adding it to the frontier. To break tier for unlabeled squares (expanding children nodes), use this order: first westward; then northward; then eastward; then southward. To break tier for labeled squares (picking one child node to expand), the smallest label is picked first.

Follow the same way as done in the class to show the search steps with labels inside circles for the A* search. The format of your output should look like this:

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```

Only labels up to 3 are shown. Please replace the rest [ ] with the correct labels (two digits for each) as needed. You don't need to show $g(n)$ and $h(n)$ values in the table.

2 Submission

Form a group if you want to work with another student on Canvas. Please follow the rubrics below:

1. 10/70: Report with screenshots
2. 10/70: Correctness of the outcomes
3. 15/70: Data structure: a priority queue for the frontier set and a hash table for the explored set
4. 15/70: Calculation of $f(n) = g(n) + h(n)$
5. 10/70: Adding leaves into the frontier
6. 10/70: Picking the smallest $f(n)$

In your report, each screenshot should include your usernames and the current time, which show that you did it by yourselves. For Items 3-6, please highlight the part of your code and provide some explanation, respectively.

Specify the contribution made by each member if you work as a group. The report should be written in a ".docx", ".doc", or ".pdf" format. Submit the report and the source code to the assignment folder P1 on Canvas. Any compression file format such as `.zip` is not permitted.