Artificial Intelligence: Programming 1 (P1)
A* Search Algorithm

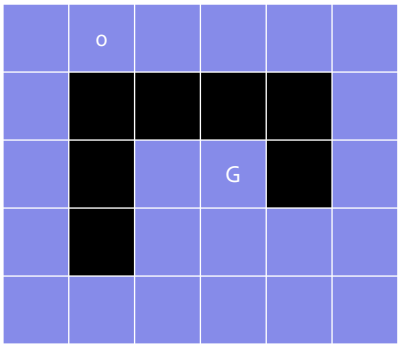
Instructor: Dr. Shengquan Wang

Due Time: 10PM, 7/9/2025

In this programming assignment, we aim to implement A* search algorithm we have learned in class.

1 Instructions

We consider a maze under a windy condition as shown in the following figure. We assume that the wind



comes from the east and the cost of one step for the agent is defined as follows: 1 for moving westward; 2 for moving northward or southward; 3 for moving eastward. We assume that the square labeled with 0 is the starting square and the goal square is labelled with "G" and all dark-shaded squares are obstacles.

For A* search algorithm, we use a modified Manhattan distance used in class as the heuristic function $h(n)$ by considering the windy situation. For example, for the start node, the agent has to move at least 2 steps eastward and 2 steps southward in order to reach the goal. Therefore, we have $h(n) = 3*2+2*2 = 10$ at the start 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. The format of your output should look like this (00 and 01 are shown as an example and GG is the goal):

```
01  00  []  []  []  []
[]  ##  ##  ##  ##  []
[]  ##  []  GG  ##  []
[]  ##  []  []  []  []
[]  []  []  []  []  []
```

2 Submission

Form a group if you want to work with another student on Canvas. Specify the contribution made by each member if you work as a group. Please follow the rubrics below:

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

Each screenshot should include your username and the current time, which show that you did it by yourself.

For Items 3-6, please highlight the part of your code and provide some explanation, respectively.

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.