

# Fundamental of Artificial intelligence

## Homework 1

You have a 5x5 grid representing a map. Each cell in the grid can either be empty (walkable) or contain an obstacle (non-walkable). Use the A\* algorithm to find the shortest path from the start position to the goal position. You can only move horizontally or vertically.

<b>S</b>	.	.	<b>#</b>	.
.	<b>#</b>	.	<b>#</b>	.
.	<b>#</b>	.	.	.
.	.	<b>#</b>	<b>#</b>	.
.	.	.	<b>#</b>	<b>G</b>

- S marks the start position.
- G marks the goal position..
- . represents walkable cells.
- # represents obstacles.

### Instructions:

1. **Initialize the Grid:** Create a 5x5 grid using the representation above.
2. **Define the Start and Goal Positions:**
  - Start: (0, 0)
  - Goal: (4, 4)
3. *Implement the A Algorithm.\**
  - Use a priority queue to keep track of the nodes to be explored.
  - Use a heuristic function (Manhattan distance) to estimate the cost from the current node to the goal.
  - Track the cost to reach each node from the start.
  - Track the path taken to reconstruct the final path once the goal is reached.
4. **Output the Path:** Print the optimal path as list of location pairs

[(0,0) ,(0,1), (0,2) (1,3) .....]

**Given this code :**

```
grid = [  
    ['S', '.', '.', '#', '.'],  
    ['.', '#', '.', '#', '.'],  
    ['.', '#', '.', '.', '.'],  
    ['.', '.', '#', '#', '.'],  
    ['.', '.', '.', '#', 'G']  
]
```

Build a (C++ or Python) function that implement A\* star algorithm on this searching problem and return the optimal path between S and G .

The path cost is the actual cost used to travel from the start node to the current node n. Each move (up, down, left, right) has the same cost, which is the number of steps taken from the start to the current node.

The heuristic function to be used :

```
def heuristic(a, b):  
    return abs(a[0] - b[0]) + abs(a[1] - b[1])
```

a is the location of any state and b is the location of the goal state

**Please read and understand this article to learn how to implement A\* using python:**

[https://www.codeease.net/programming/python/a\\*-implementation-in-python](https://www.codeease.net/programming/python/a*-implementation-in-python)

**Note :**

- 1) You should be able to run your code and show the optimal path printed in the screen as required.
- 2) You should understand every single line in your code.
- 3) You should be able to discuss how you have described each state.

**Good luck**