CYBER-PHYSICAL SYSTEMS AND ROBOTICS

Lab 3. Motion planning

# Preparation

1. The main use for decorators in python is so that users of a certain class don’t need to make changes to their code when certain functions of said class are changed. In the end it allows us to define a method and access it as an attribute. In our case, it is used to call the grid\_map method so it is always updated.
2. (x, y) = (−4, −4) (r,c) = (8,0)

(r,c) = (0,8) (x,y) = (4,4)

# Code

## Creating an admissible heuristic

In order to create an admissible heuristic, the only condition is to make an optimistic guess of how far our robot is from the goal. The easiest way to do this when dealing with a discrete distance, like in our case, is computing the Manhattan distance between any given point and the start. This is the number of steps from the starting point to a certain square without taking walls into account. The following code is a simple implementation of this idea.

def \_compute\_heuristic(self, goal: Tuple[float, float]) -> np.ndarray:  
 *"""Creates an admissible heuristic.  
  
 Args:  
 goal: Destination location in (x,y) coordinates.  
  
 Returns:  
 Admissible heuristic.  
  
 """* map\_rows, map\_cols = np.shape(self.\_map.grid\_map)  
  
  
 heuristic = np.ndarray(shape = (map\_rows, map\_cols), dtype = int)  
  
 goal\_rc = self.\_xy\_to\_rc(goal)  
  
 for i in range(0, map\_rows):  
 for j in range (0, map\_cols):  
 heuristic[i][j] = abs(goal\_rc[0] - i) + abs(goal\_rc[1] - j)  
  
 return heuristic

Code 1: Heuristic computation

As explained before, each grid space is assigned a value depending on its manhattan distance to the start. In Figure 1 we have the resulting heuristic which we will use for the A\* algorithm implemented in the following steps.



Figure 1: Resulting heuristic array

Note that the order is flipped when compared with the map, but it is symmetrical and is only a product of naming rows and columns in a different order. Once we have it we can start calculating the optimal path.