Team Bravo
Brickea, 2020.2.17
Pathfinding Demo

```
from queue import *
import numpy as np
from matplotlib import pyplot as plt
import networkx as nx
```

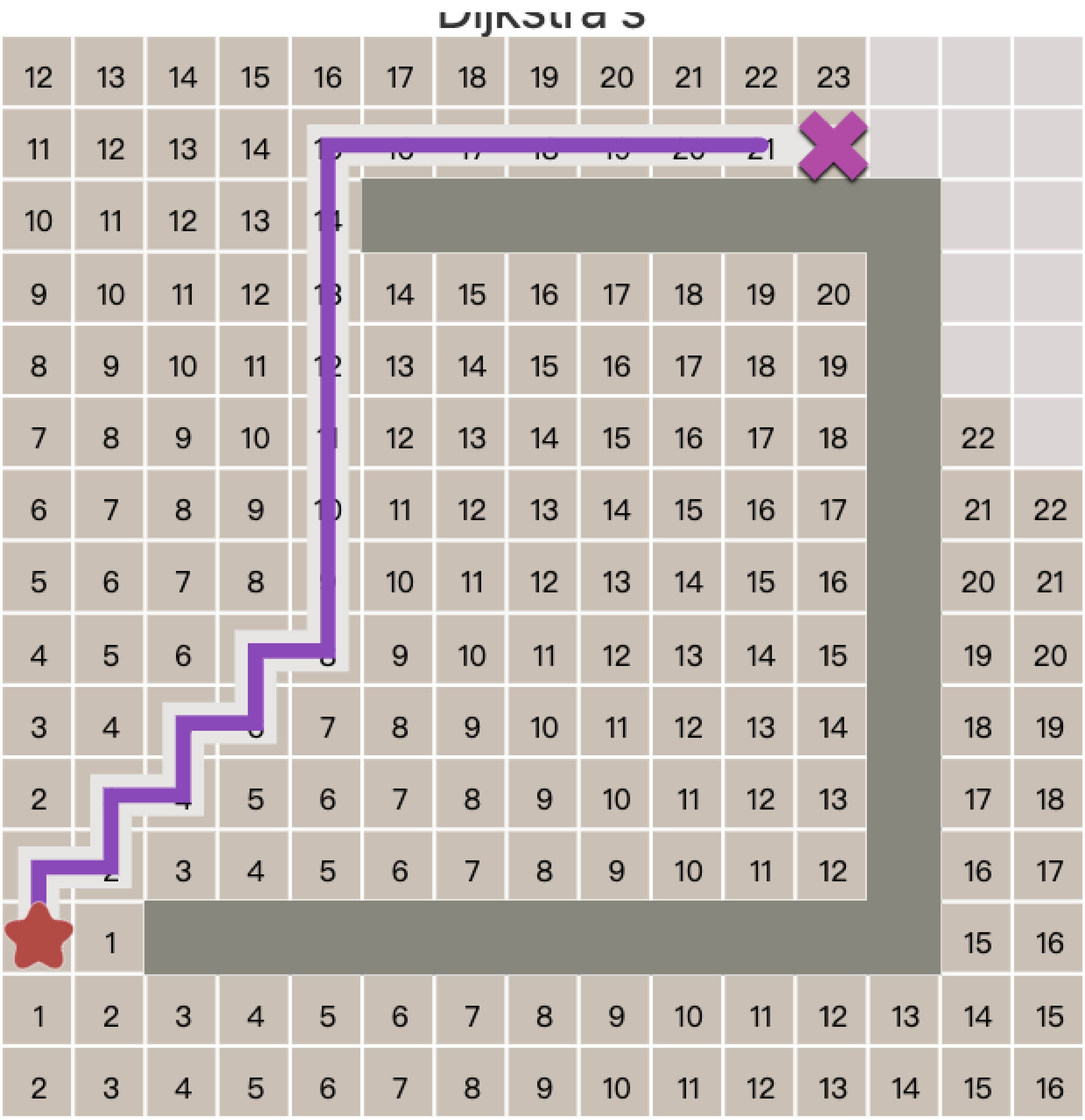
Methodology

Introduction to the A* Algorithm

- Breadth First Search
- Dijkstra’s Algorithm
- A*

~~Import the coordinate data~~

Simluation data



12	13	14	15	16	17	18	19	20	21	22	23			
11	12	13	14	15	16	17	18	19	20	21	✖			
10	11	12	13	14										
9	10	11	12	13	14	15	16	17	18	19	20			
8	9	10	11	12	13	14	15	16	17	18	19			
7	8	9	10	11	12	13	14	15	16	17	18		22	
6	7	8	9	10	11	12	13	14	15	16	17		21	22
5	6	7	8	9	10	11	12	13	14	15	16		20	21
4	5	6		8	9	10	11	12	13	14	15		19	20
3	4		6	7	8	9	10	11	12	13	14		18	19
2		4	5	6	7	8	9	10	11	12	13		17	18
	2	3	4	5	6	7	8	9	10	11	12		16	17
★	1												15	16
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

During the simulation, the map node will have three states

- 0 : Not been visited by algorithm
- 1 : Have been visited by algorithm
- 2 : Have a wall so it cannot pass through

```
# Initiate the map for 15 X 15
# The (0,0) is the top left element
simulate_map = np.zeros((15,15))
simulate_map.shape
```

```
(15, 15)
```

```
# This step is to simulate the information of the corresponding wall
def init_wall(start,end,current_map):
    if start[0] == end[0]:
        # The wall is in a row
        for i in range(start[1],end[1]+1):
            current_map[start[0]][i] = 2
    else:
        # The wall is in a column
        for j in range(start[0],end[0]+1):
            current_map[j][start[1]] = 2
```

```
# Initiate the wall
# From (12,2) to (12,12)
init_wall((12,2),(12,12),simulate_map)
# From (12,12) to (2,12)
init_wall((2,12),(12,12),simulate_map)
# From (2,5) to (2,12)
init_wall((2,5),(2,12),simulate_map)
simulate_map
```

```
array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 2., 2., 2., 2., 2., 2., 2., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 2., 2., 2., 2., 2., 2., 2., 2., 2., 2., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

Breadth First Search Algorithm

```
class BFS_PathFind(object):
    def __init__(self,start,end,current_map):
        # Start,end should be a tuple with x,y
        # current_map should be a 2-D array
        self.start = start
        self.end = end
        self.current_map = current_map
        self.map_shape = current_map.shape
        self.came_from = [[() for i in range(current_map.shape[0])] for j in range(current_map.shape[1])]


    def is_have_came_from(self,point):
        return not self.came_from[point[0]][point[1]] == ()

    def calculate_came_from(self):
        frontier = []
        frontier.append(self.start)
        self.came_from[self.start[0]][self.start[1]] = self.start
        while len(frontier)!=0:
            current = frontier.pop(0)

            if current == self.end:
                # If we found the end point the exit the algorithm
                return self.came_from

            # Neiborhood
            top = (current[0]-1,current[1])
            left = (current[0],current[1]-1)
            buttom = (current[0]+1,current[1])
            right = (current[0],current[1]+1)

            # Top path within map and is not a wall
            if top[0] > -1 and self.current_map[top[0]][top[1]]!=2:
                if not self.is_have_came_from(top):
                    # If we dont have came from for this point
                    self.came_from[top[0]][top[1]] = current
                    frontier.append(top)

            # Left path within map and is not a wall
            if left[1] > -1 and self.current_map[left[0]][left[1]]!=2:
                if not self.is_have_came_from(left):
                    # If we dont have came from for this point
                    self.came_from[left[0]][left[1]] = current
                    frontier.append(left)

            # Buttom path within map and is not a wall
            if buttom[0] < self.map_shape[0] and self.current_map[buttom[0]][buttom[1]]!=2:
                if not self.is_have_came_from(buttom):
                    # If we dont have came from for this point
                    self.came_from[buttom[0]][buttom[1]] = current
                    frontier.append(buttom)

            # Right path within map and is not a wall
            if right[1] < self.map_shape[1] and self.current_map[right[0]][right[1]]!=2:
                if not self.is_have_came_from(right):
                    # If we dont have came from for this point
                    self.came_from[right[0]][right[1]] = current
                    frontier.append(right)
        return self.came_from

    def find_path(self):
        current = self.end
        while current != self.start:
            self.current_map[current[0]][current[1]] = 1
            current = self.came_from[current[0]][current[1]]
        self.current_map[current[0]][current[1]] = 1
        return self.current_map
```

```
%%time
test = BFS_PathFind((5,7),(1,11),simulate_map)
test.calculate_came_from()
test.find_path()
```

```
CPU times: user 744 µs, sys: 2 µs, total: 746 µs
Wall time: 749 µs





array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 1., 1., 1., 1., 1., 1., 1., 1., 0., 0., 0.],
       [0., 0., 0., 0., 1., 2., 2., 2., 2., 2., 2., 2., 2., 0., 0.],
       [0., 0., 0., 0., 1., 1., 1., 1., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 1., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 1., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 2., 0., 0.],
       [0., 0., 2., 2., 2., 2., 2., 2., 2., 2., 2., 2., 2., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```