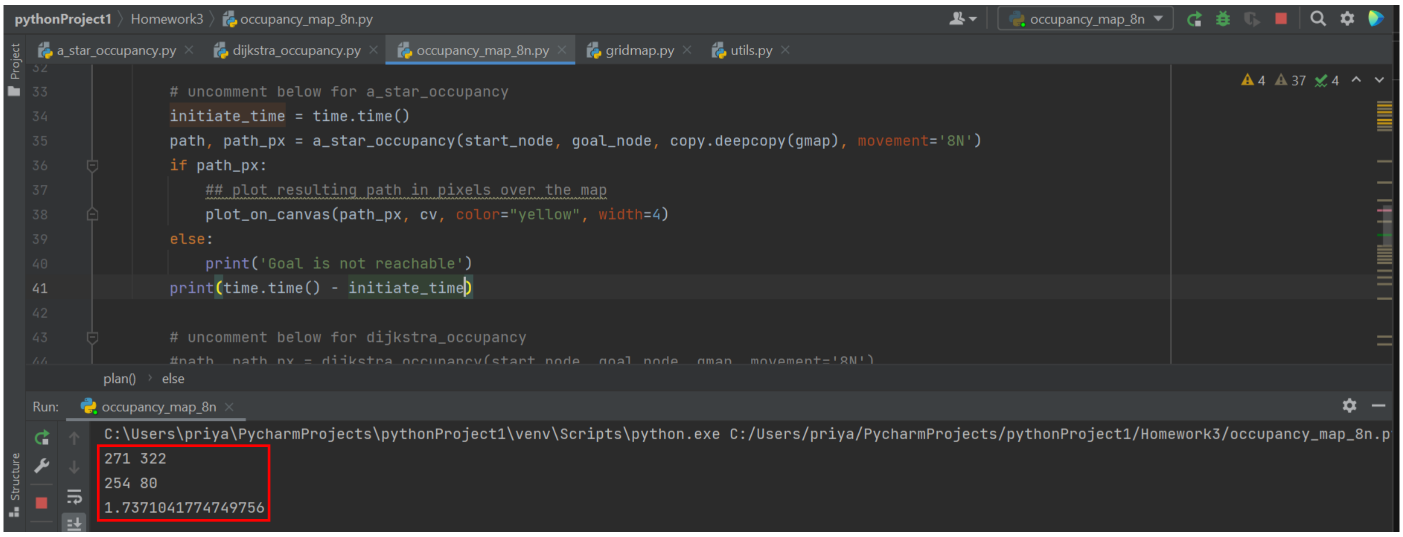
PART-B

All codes were submitted previously and can be found in a zip folder on Canvas.

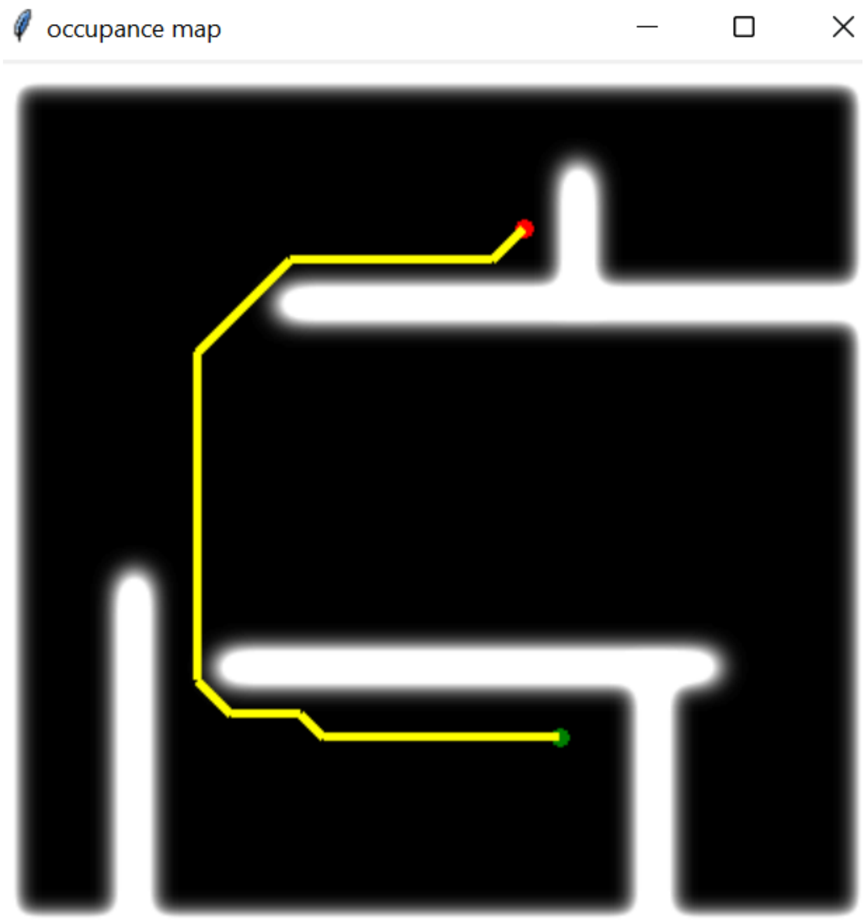
1.a. Demo existing reference and get to know the behaviour of its path search. (The demo run file is: examples/occupancy_map_8n.py)

Solution:



```
    # uncomment below for a_star_occupancy
    initiate_time = time.time()
    path, path_px = a_star_occupancy(start_node, goal_node, copy.deepcopy(gmap), movement='8N')
    if path_px:
        ## plot resulting path in pixels over the map
        plot_on_canvas(path_px, cv, color="yellow", width=4)
    else:
        print('Goal is not reachable')
    print(time.time() - initiate_time)

    # uncomment below for dijkstra_occupancy
    #path, path_px = dijkstra_occupancy(start_node, goal_node, gmap, movement='8N')
```

```
C:\Users\priya\PycharmProjects\pythonProject1\venv\Scripts\python.exe C:/Users/priya/PycharmProjects/pythonProject1/Homework3/occupancy_map_8n.p
271 322
254 80
1.7371041774749756
```



The figure represents the use of A* algorithm to find the path and traverse the graph from start to end node. The A* algorithm features the use of a heuristic function to estimate the location of the end node.

Also, It took around 1.73 seconds to execute this code.

1.b. Implement occupancy gridmap-based Dijkstra for same functionality as (1a)

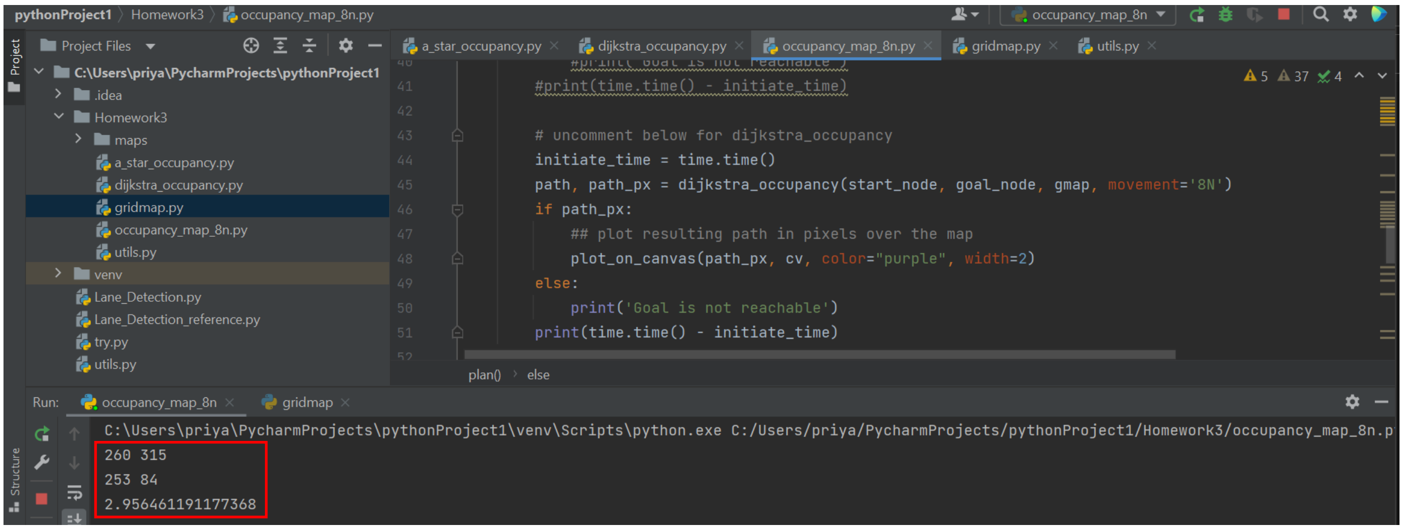
Solution:

The Dijkstra algorithm was defined as –

```
def dijkstra_occupancy(start_m, goal_m, gmap, movement='8N', occupancy_cost_factor=3):
```

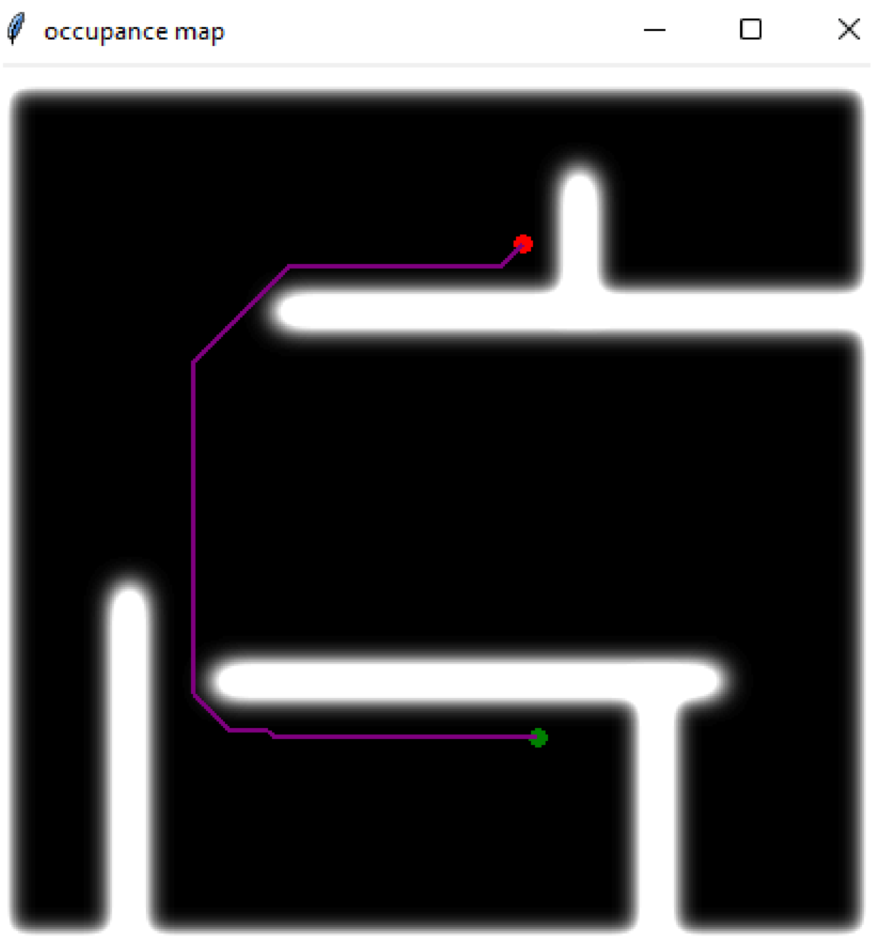
The primary difference between the A* and the Dijkstra algorithm is the absence of the distance heuristic function in Dijkstra algorithm; which is present in the A* algorithm. This is the reason why Dijkstra algorithm takes more time in finding the goal node when compared to the A* algorithm.

For instance, in the below example Dijkstra took around 2.95 seconds to find the goal node which is more than what A* algorithm took (i.e., 1.73 seconds).



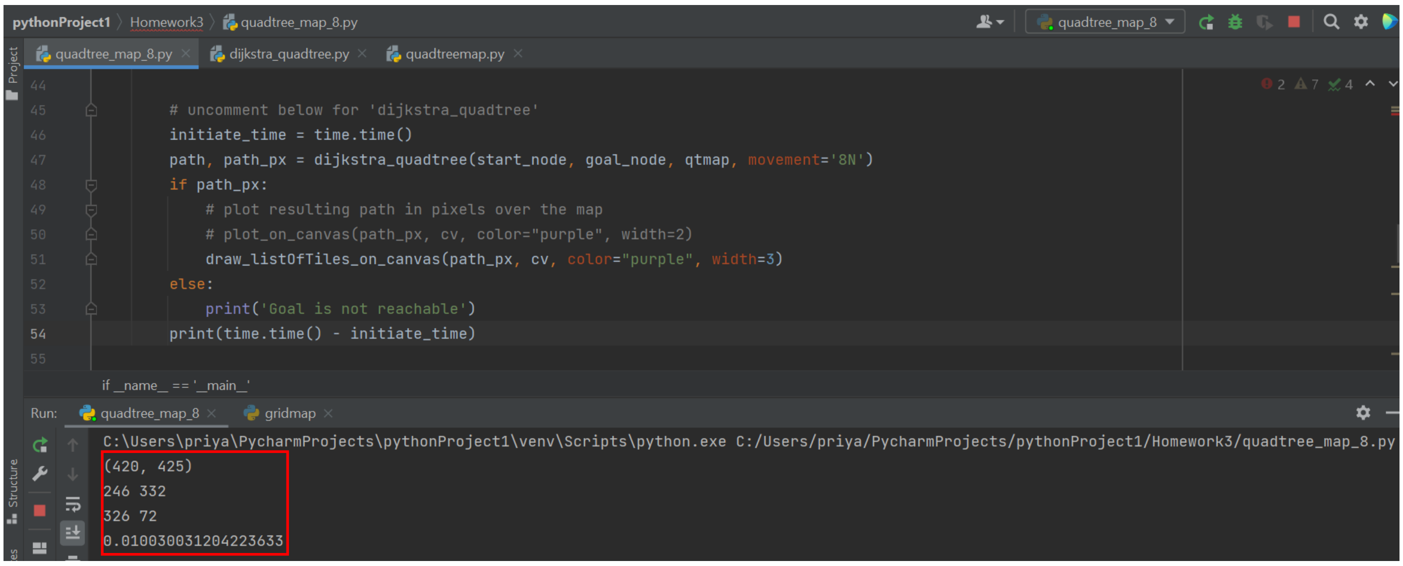
```
    #print(time.time() - initiate_time)

    # uncomment below for dijkstra_occupancy
    initiate_time = time.time()
    path, path_px = dijkstra_occupancy(start_node, goal_node, gmap, movement='8N')
    if path_px:
        ## plot resulting path in pixels over the map
        plot_on_canvas(path_px, cv, color="purple", width=2)
    else:
        print('Goal is not reachable')
    print(time.time() - initiate_time)
```

```
C:\Users\priya\PycharmProjects\pythonProject1\venv\Scripts\python.exe C:/Users/priya/PycharmProjects/pythonProject1/Homework3/occupancy_map_8n.p
260 315
253 84
2.956461191177368
```



2.a. Demo existing reference and get to know the behaviour of its path search. (2’) The demo run file is: examples/quadtree_map_8n.py

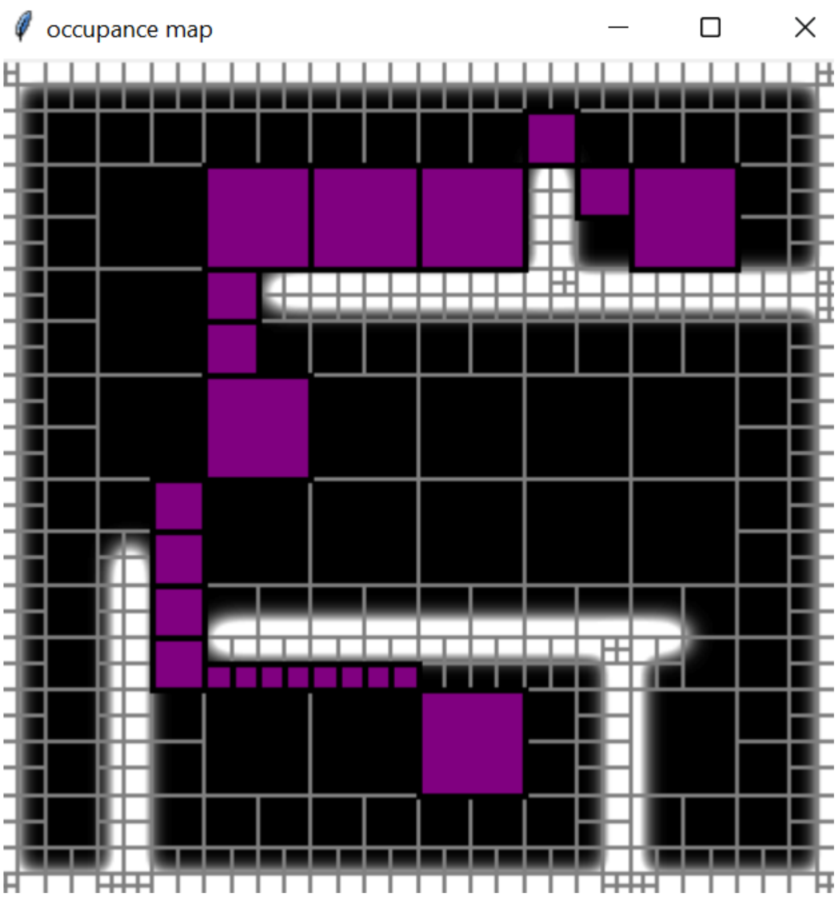
Solution:



```
        # uncomment below for 'dijkstra_quadtree'
        initiate_time = time.time()
        path, path_px = dijkstra_quadtree(start_node, goal_node, qtmap, movement='8N')
        if path_px:
            # plot resulting path in pixels over the map
            # plot_on_canvas(path_px, cv, color="purple", width=2)
            draw_listOfTiles_on_canvas(path_px, cv, color="purple", width=3)
        else:
            print('Goal is not reachable')
        print(time.time() - initiate_time)
```

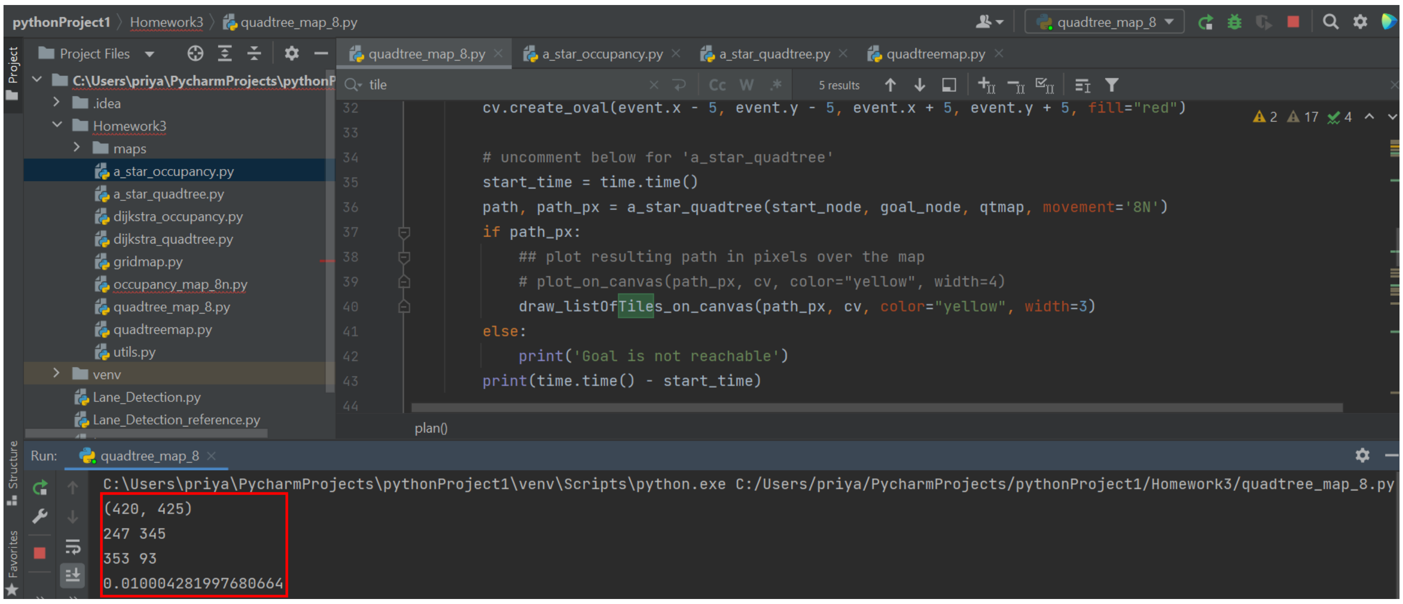
```
C:\Users\priya\PycharmProjects\pythonProject1\venv\Scripts\python.exe C:/Users/priya/PycharmProjects/pythonProject1/Homework3/quadtree_map_8.py
(420, 425)
246 332
326 72
0.010030031204223633
```

The output below uses Dijkstra’s algorithm and took around 0.01003 seconds to execute.



2.b. Implement Quadtree map-based A* for same functionality as (2a)

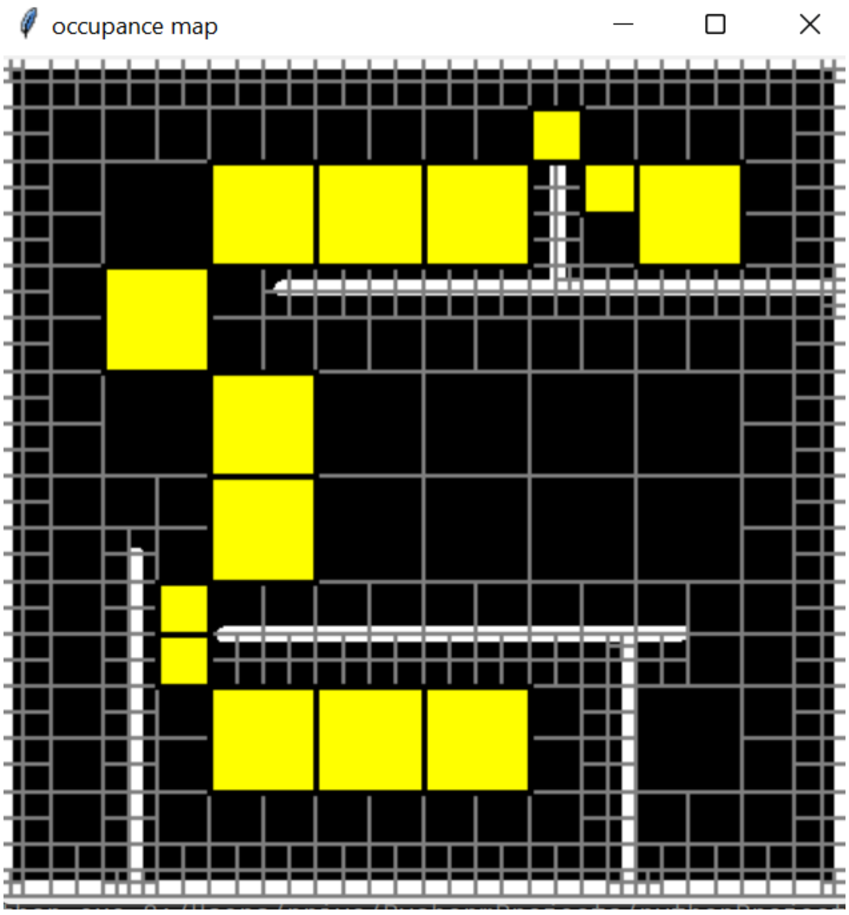
Solution:



```python
        cv.create_oval(event.x - 5, event.y - 5, event.x + 5, event.y + 5, fill="red")

        # uncomment below for 'a_star_quadtree'
        start_time = time.time()
        path, path_px = a_star_quadtree(start_node, goal_node, qtmap, movement='8N')
        if path_px:
            ## plot resulting path in pixels over the map
            # plot_on_canvas(path_px, cv, color="yellow", width=4)
            draw_listOfTiles_on_canvas(path_px, cv, color="yellow", width=3)
        else:
            print('Goal is not reachable')
        print(time.time() - start_time)
```

```
C:\Users\priya\PycharmProjects\pythonProject1\venv\Scripts\python.exe C:/Users/priya/PycharmProjects/pythonProject1/Homework3/quadtree_map_8.py
(420, 425)
247 345
353 93
0.010004281997680664
```

The output below uses A* algorithm and took around 0.010004 seconds to execute. (For A* algorithm a heuristic distance function should be added.)


occupance map