TDT4136 Introduction to artificial intelligence - Assignment 2

Elias Søvik Gunnarsson, MTIØT

September 14, 2020

1   Overview

The objective in this assignment is to become familiar with the A* algorithm by applying it to a classical use case for A*, namely that of finding the shortest path in a two-dimensional grid-like world.

2   How to run the code

Simply run the corresponding python code for each task i.e. **part_1.py** for part 1 and so on. **Map.py** contains provided hand-out-code, while **astar.py** contains implementation of A* algorithm based on provided pseudo code in *Essentials of the A* Algorithm* [1] as well as additional functions.

3   Part 1 - Grid with obstacles

3.1   Task 1

You and your friend arrived at Samfundet only five minutes ago, but you've already managed to get separated. Being the resourceful person that you are, you call your friend, which tells you that they went looking for you and is currently located at Strossa. Your task is therefore to find the shortest path from Rundhallen (your location) to Strossa as seen in Figure 1 using your implementation of the A algorithm.*

Figure 2 shows the solution for task 1 provided by the A* algorithm.

3.2   Task 2

When you arrive at Strossa, your friend is nowhere to be found. You deduce that they have probably moved on and you missed them in the stairs. You call your friend again and find out that they are now at Selskapssiden. Your task is now to use your A implementation to find the shortest path from Strossa to Selskapssiden as shown in Figure 3.*
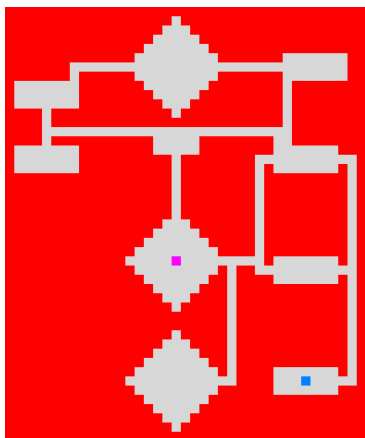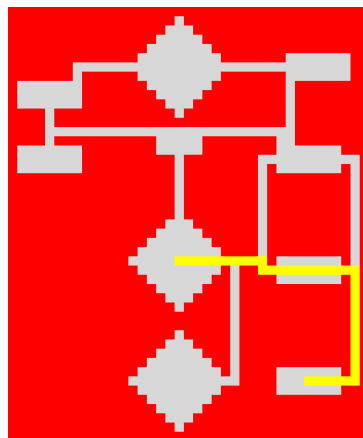
Figure 1: Start and goal location for task 1.

Figure 2: Solution for task 1 provided by A*.

shows the solution for task 2 provided by the A* algorithm.
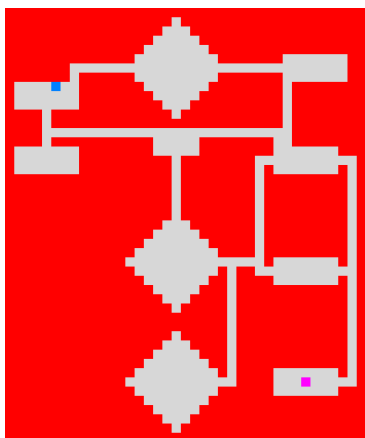

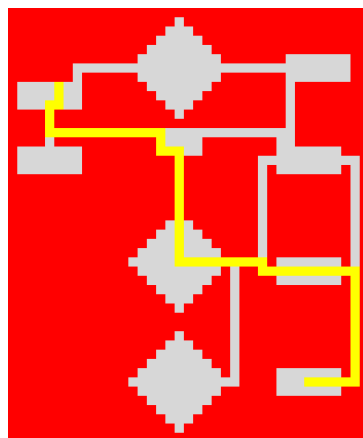Figure 3: Start and goal location for task 2.

Figure 4: Solution for task 2 provided by A*.

4 Part 2 - Grids with different cell costs

In this part of the assignment, your code from Part 1 will be extended to take different cell costs into account for the path finding process.

4.1 Task 3

Tonight you are going to a concert at Samfundet. The concert is held at Klubben and will start at 21. You arrived early to enjoy a Lyche-Burger with some friends before going to the concert. The time is 20:45 and you should get going. The stairs from Rundhallen to Edgar have unfortunately become packed with all the concert goers arriving. Use your A*

implementation to find the path from Lyche to Klubben with the lowest cost using the map shown in Figure 5.

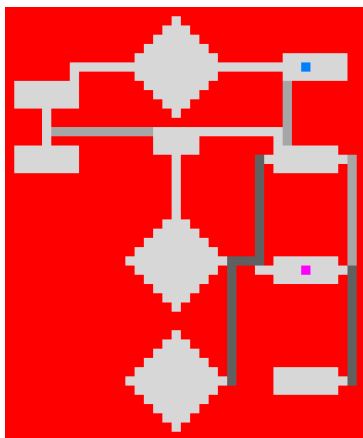Figure 6 shows the solution for task 3 provided by the A* algorithm.

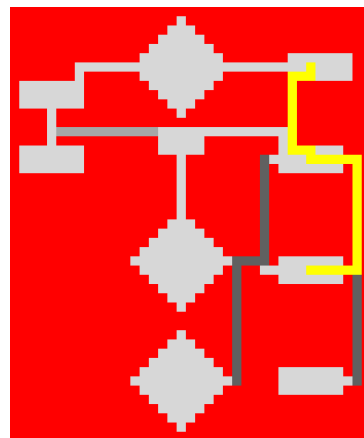Figure 5: Start and goal location for task 3.

Figure 6: Solution for task 3 provided by A*.

4.2   Task 4

You remember seeing a poster announcing a free chocolate cake party at Edgar this very evening. Edgar is therefore filled with hungry students scrambling to eat as much cake as possible. Use your A* implementation to find the new least-cost path from Lyche to Klubben, now considering the cake party at Edgar. The map is shown in Figure 8.

Figure 4 shows the solution for task 1 provided by the A* algorithm.
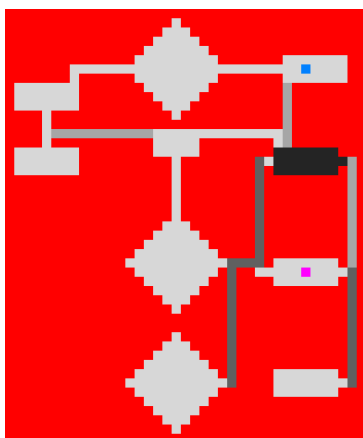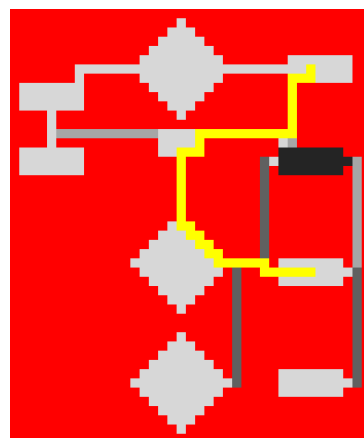

Figure 7: Start and goal location for task 4.

Figure 8: Solution for task 4 provided by A*.

5 Part 3 - Moving Goal (Optional)

In the previous parts, we have only used static goals. In this final part we will use a moving goal. Your algorithm will therefore need to take this movement into account. We have limited the movement of our goal to a straight line, with a constant speed of 1/4 your speed and a constant direction. You can therefore use this information to make some assumptions when designing your heuristic function h().

5.1 Task 5

After having finished the concert you feel the need for sugar! You rush down to Edgar to get some of that free chocolate cake. After having satisfied your sugar cravings you notice that you have separated from your friend again. You head to the top of Rytterhallen and call to find that they are still at Klubben. Having had one beer too many they tell you that they will be heading towards Selskapssiden and can meet you outside. Having just consumed four chocolate cakes, you experience a sugar high and you quickly estimate that with your sugar high and your friend's reduced motor skills, you can move at four times their speed. Use this information along with the knowledge that your friend will be starting out at Klubben and moving in a straight line towards Selskapssiden to improve your A* implementation to handle a moving target.

Since we know the fact that our friend is moving 1/4 of our speed with a straight line towards Selskapssiden from Klubben, we know that the initial goal position will only differ in the x-value from the actual goal after the movement. Therefore one can modify the **manhattan_distance** to estimate a new goal using the known facts. With only adding the displacement in the x-direction, the **moving_manhattan** function will help solve the task without any further modifications on the A* algorithm.

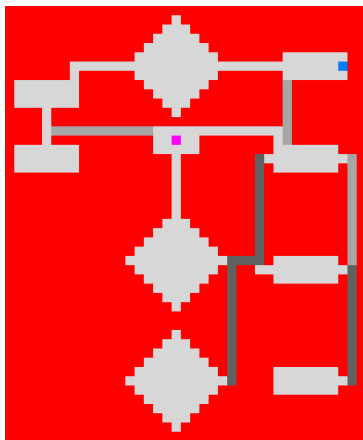Figure 10 shows the solution for task 5 provided by the A* algorithm.
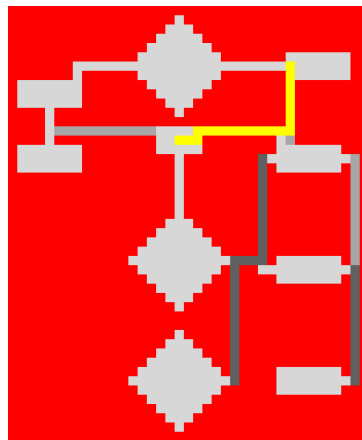

Figure 9: Start and goal(moving) location for task 5.

Figure 10: Solution for task 5 provided by A*.

References

[1] Course material - TDT4136 Introduction to Artificial Inteligence, *Essentials of the A* Algorithm*, (Norwegian University of Science and Technology (NTNU), Trondheim, 2020).