Assignment 1

Pathfinding- A*, DFS, BFS, UCS

Kenza Rchi 114592

Supervised by: Dr. Tajjeeddine RACHIDI

Spring 2022 **Intro To Artificial Intelligence CSC 4301**

Introduction:

Pathfinding algorithms are map navigation techniques that allow us to find a route between two points. Different algorithms have different advantages and disadvantages, often in terms of the algorithm's efficiency and the efficiency of the route it generates.

The problem of finding the shortest path is considered one of the classic graph problems, and it has been studied since the 19th century. It can be used in the following scenarios:
Getting directions from one location to another. This is the most common application, and web mapping tools like Google Maps use it, or a variant of it, to provide driving directions.
The algorithm can be used to determine the degrees of separation between people in social networks. When you look at someone's LinkedIn profile, for example, it will tell you how many people separate you in the connections graph and list your mutual connections.

Pathfinding- A*, DFS, BFS, UCS implementation using Unity engine:

This project is an inspiration from E1, E2, and E3 of **Sebastian Lague** on YouTube, with my teammate **Asma Dalil,** we tried to build our own environment using unity, and we implemented the following pathfinding algorithms :

BFS : Breadth First Search is a vertex-based method for finding the shortest path in a graph. It employs a Queue data structure that follows the first in, first out principle. In BFS, one vertex is visited and marked at a time, then its neighbors are visited and stored in the queue.

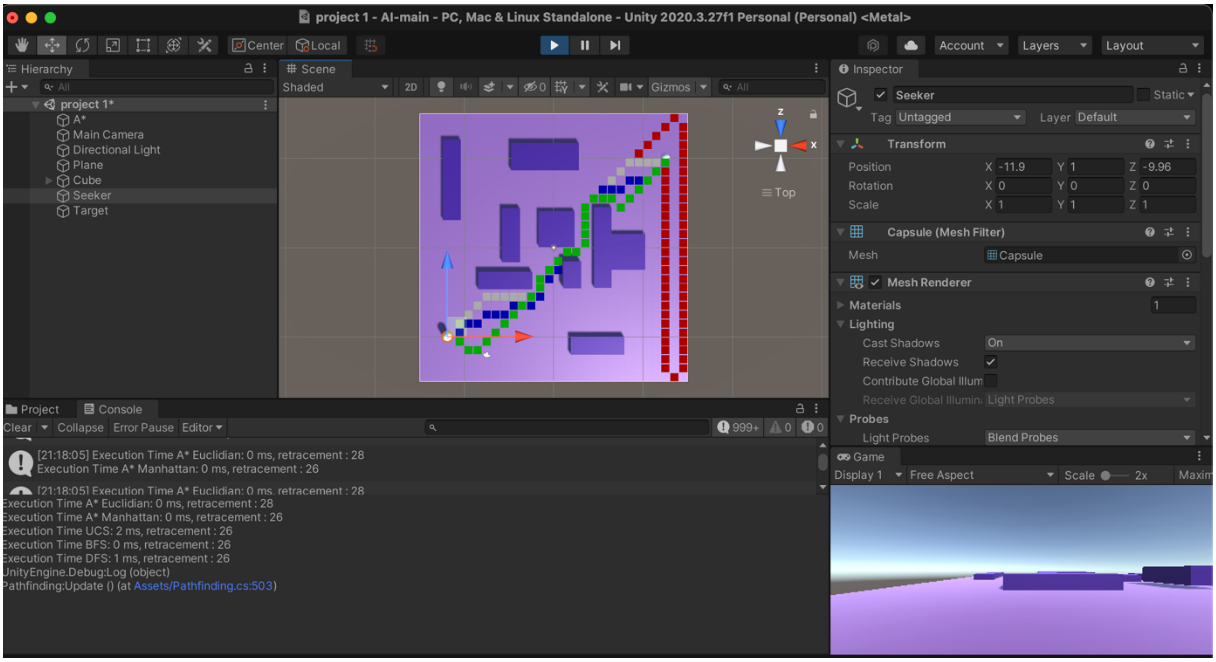
DFS: A recursive algorithm for searching all the vertices of a graph or tree data structure is called depth first search or depth first traversal. Traversing a graph entails visiting all of its nodes.

UCS: Uniform-cost search is an uninformed search algorithm that finds a path from the source to the destination by calculating the lowest cumulative cost. Starting at the root, nodes are expanded according to the lowest cumulative cost.
A*: Algorithm extends the path that minimizes the following function: $f(n) = g(n) + h(n)$

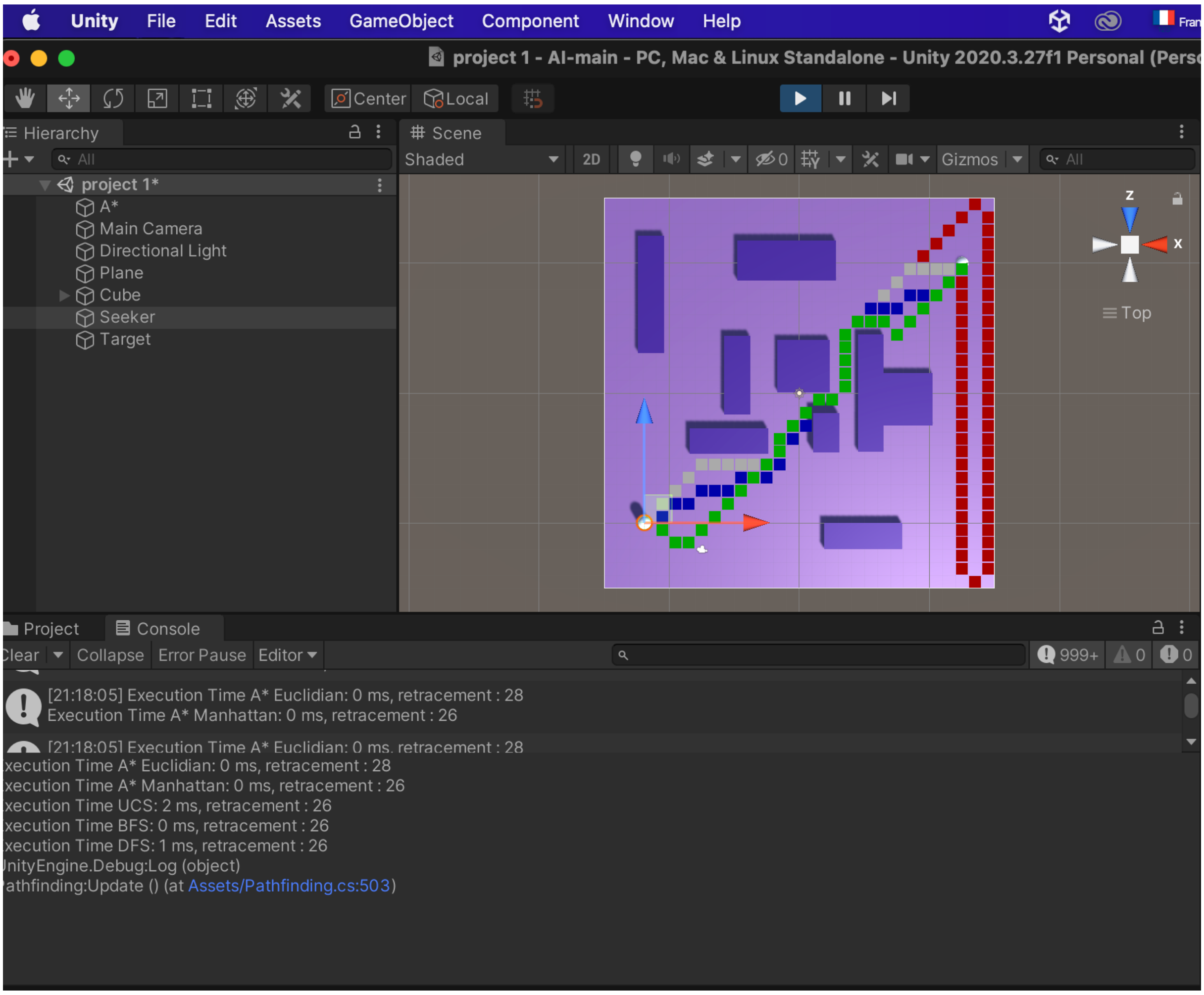
- Euclidean Distance: Euclidean Distance represents the shortest distance between two points.
- Manhattan Distance: Manhattan Distance is the sum of absolute differences between points across all the dimensions.

GitHub-Link: https://github.com/kenzarchi/AI

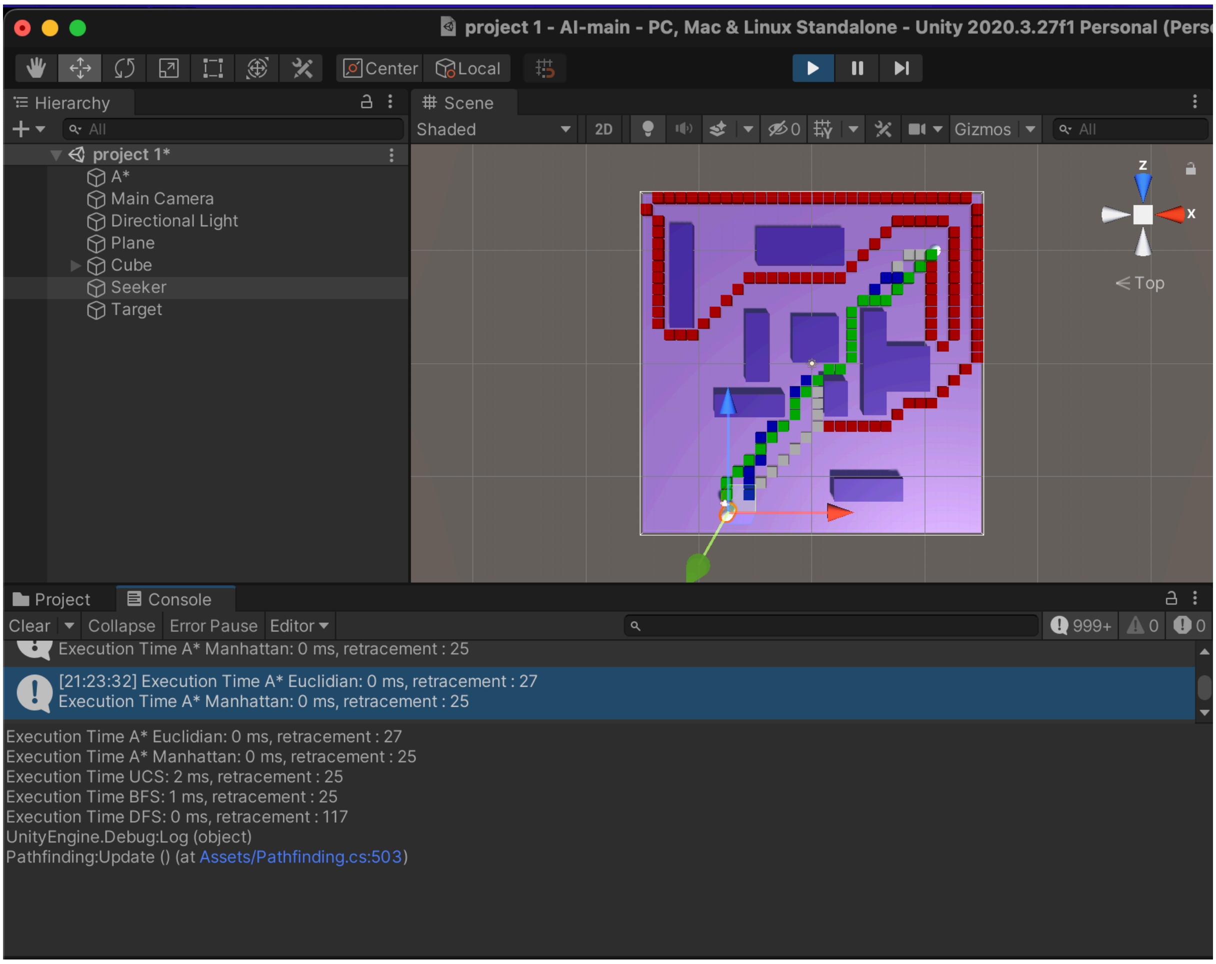
In the following part we will try to analyze different configurations



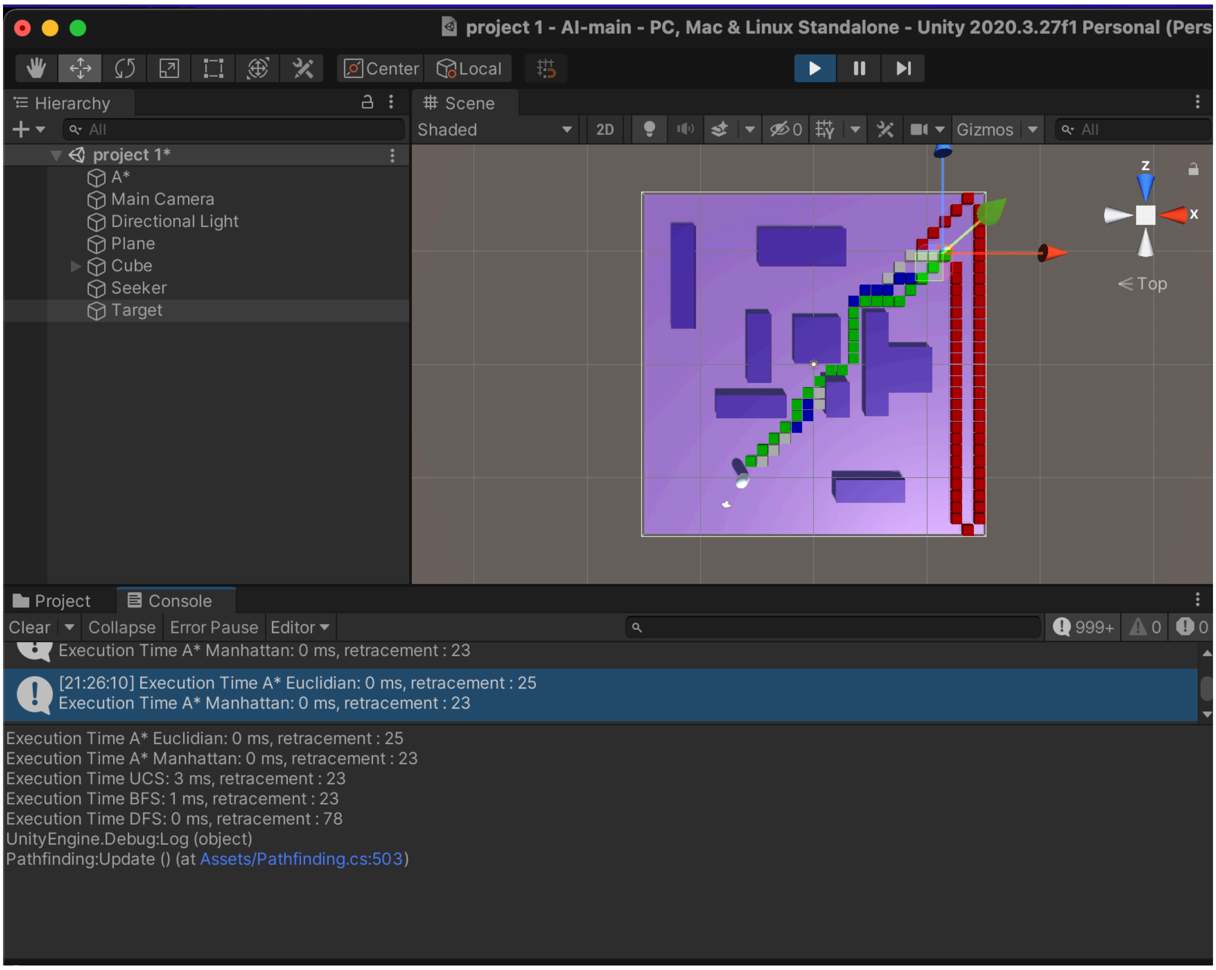
In this screenshot from the project, we have the seeker in position: (-11.9, 1, -9,96) we can see that it took 0ms for A* to reach the target with 28 retracements with the Euclidian distance, and 26 retracement with Manhattan distance. We can see that BFS also took the same time and the same retracement as A* Manhattan, while it took 2ms to reach the target with 26 retracements, It is the same number of retracements for DFS but it took 1ms to reach the target.



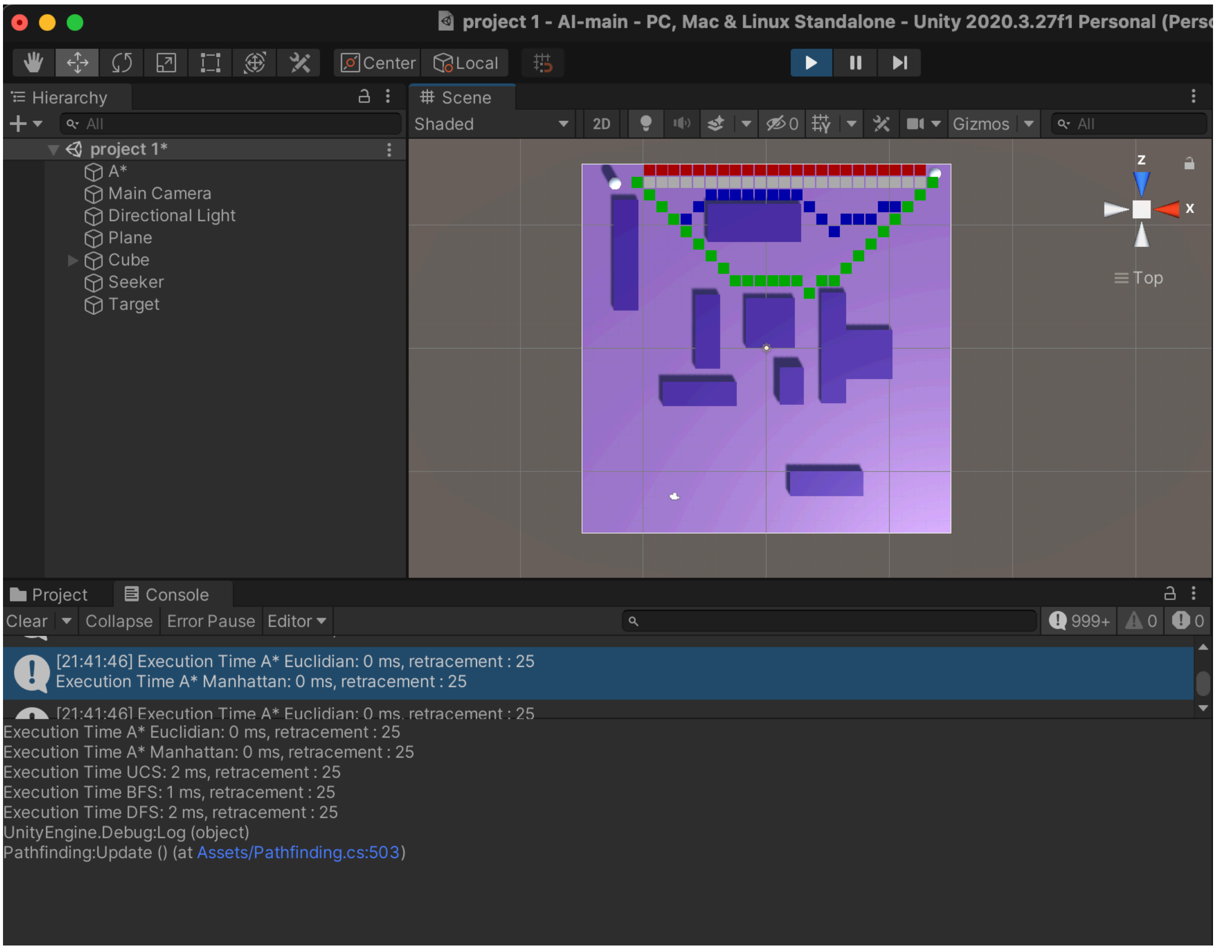
We can see here that the number of retracement nodes is 26 for all the pathfinding methods, expect for A* Euclidian it was 28 retracement node and we can see again that UCS took 2ms to reach the target which is the highest comparing to the others, while again A* took 0ms again to reach the target which makes it the fastest so far.



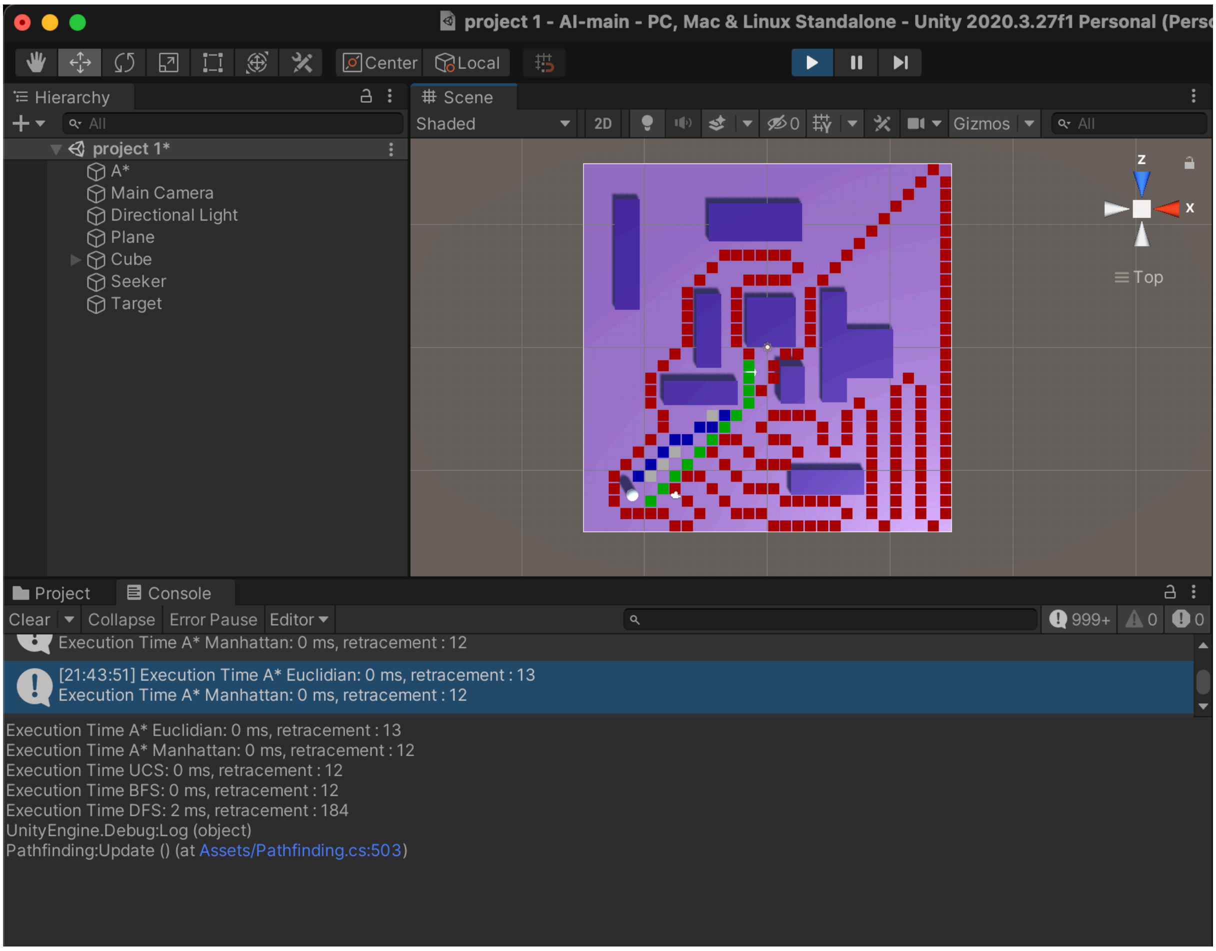
In this case again have A* that reached the target in no time and took 25 retracement node with Manhattan distance and 27 with Euclidian, DFS this time took 0ms and 117 node retracement to reach the target which make it the fastest but it took a lot of space to expand.



Here again it is similar to the previous case, DFS is the fastest but it is the one taking the highest number of retracement nodes.



This time the target was near the seeker with less obstacles, we can clearly see that we got the same results when it comes to node retracement, A* again is the fastest to reach the target while DFS and UCS took 2ms.


project 1 - AI-main - PC, Mac & Linux Standalone - Unity 2020.3.27f1 Personal
Center
Local
Hierarchy
Scene
Shaded
2D
Gizmos
project 1*
A*
Main Camera
Directional Light
Plane
Cube
Seeker
Target
Top
Project
Console
Clear
Collapse
Error Pause
Editor
999+
Execution Time A* Manhattan: 0 ms, retracement : 12
[21:43:51] Execution Time A* Euclidian: 0 ms, retracement : 13
Execution Time A* Manhattan: 0 ms, retracement : 12
Execution Time A* Euclidian: 0 ms, retracement : 13
Execution Time A* Manhattan: 0 ms, retracement : 12
Execution Time UCS: 0 ms, retracement : 12
Execution Time BFS: 0 ms, retracement : 12
Execution Time DFS: 2 ms, retracement : 184
UnityEngine.Debug:Log (object)
Pathfinding:Update () (at Assets/Pathfinding.cs:503)