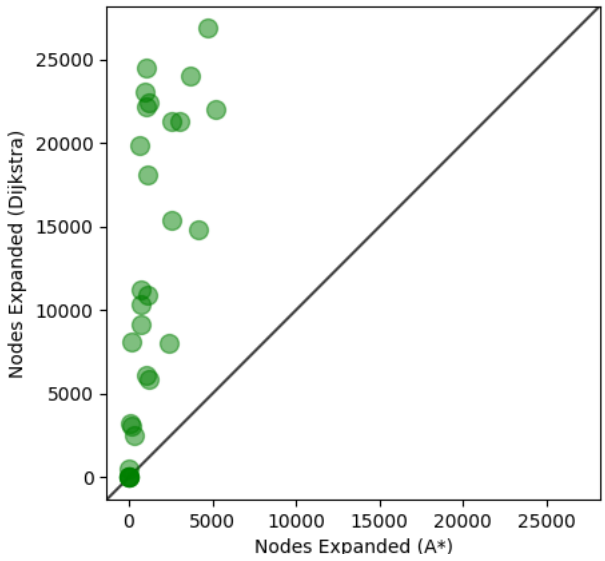
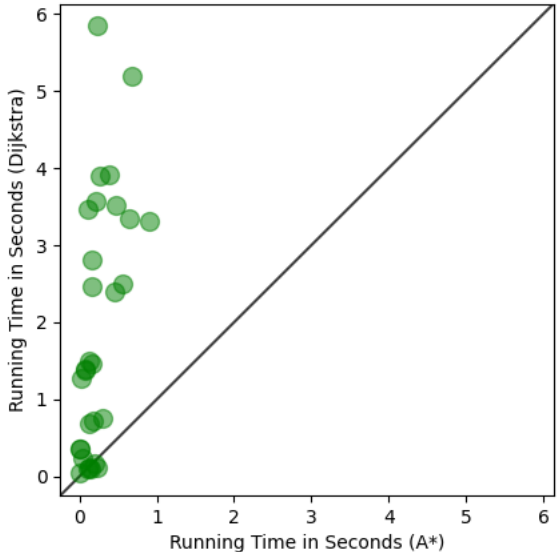
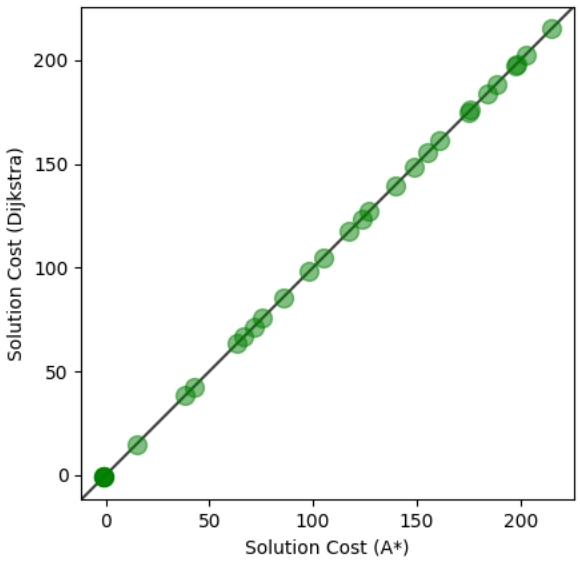
**Name: MD Saiful Islam Shovo**
**Student ID: 1608714**
**CMPUT 366**
**Assignment 1**

Analysing the Scatter Plots:





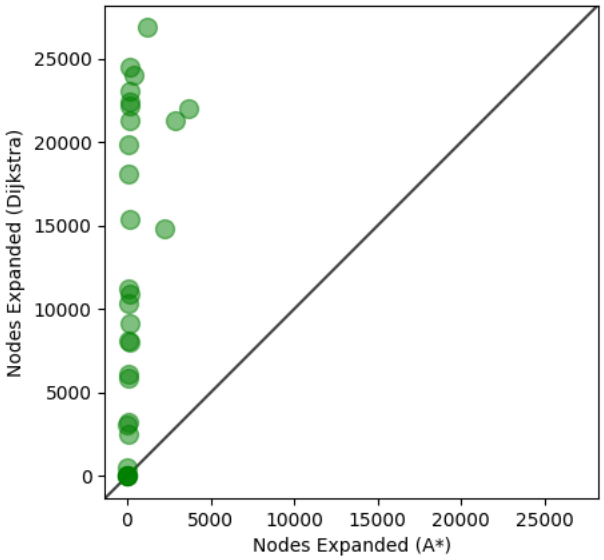

Ques: Explain the three plots that were generated. You should explain the relation between the running time with number of nodes expanded of each algorithm: are the plots identical or only similar? Why? You must also explain the results shown in the scatter plot for the solution cost. Please include the plots in your answer.

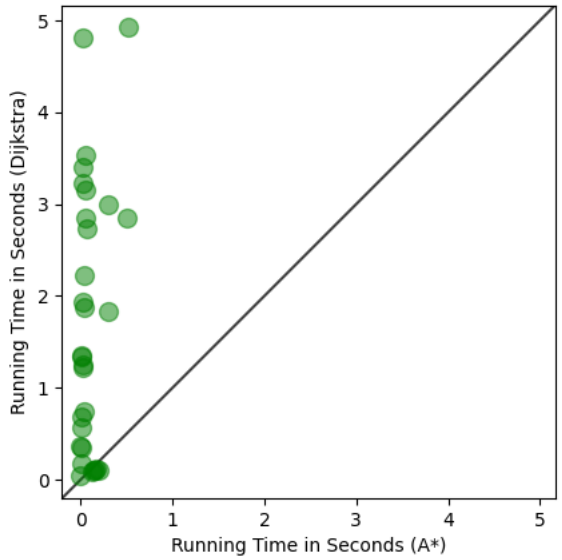
Relation between the running time with number of nodes expanded of each algorithm is very similar as the running time increase with the number of nodes expanded. Here Dijkstra takes much time because it goes through all the nodes to find the goal node, so its running time is higher and it's also expanding more nodes than A*. Where, A* is getting the goal by expanding less nodes than Dijkstra as it's using the heuristic function to get the cheapest path, because of this its running time is quicker. In the graphs it shows that Dijkstra is expanding more nodes, sometimes 25000+ and A* is expanding much less than Dijkstra. For all the test instances, A* is not going above expanding 10,000 nodes and it's running so fast as running time is less than 1 second on average. On the other hand, Dijkstra is taking more time, sometimes even close to 6 seconds.

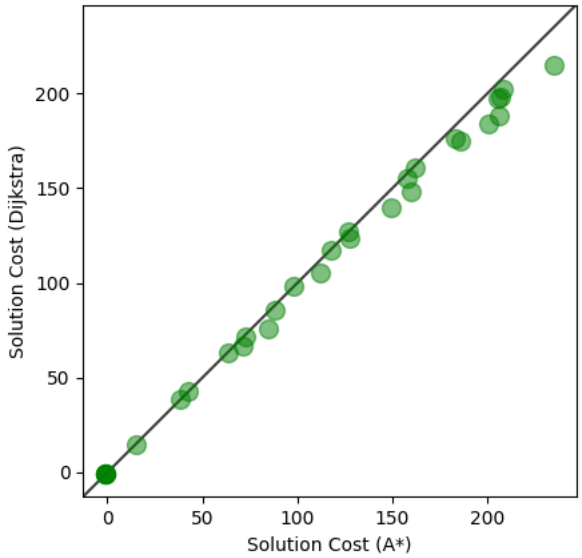
Here, the solution cost graph shows all the plots are on the middle line which means both algorithm is able to find the optimal solution. Although, Dijkstra is exploring all possible path to

find the optimal solution where A* is exploring the shortest path to achieve the optimal solution by using heuristic functions.

Ques: Next, you will change your implementation of the heuristic function used with A*. Instead of returning the heuristic value h(s) for a state as described in Equation 1, the function will return 2×h(s)—we are inflating the h-value by 2. Generate all three plots and add them to your answer: running time, nodes expanded, and solution cost. Similarly, to what was done in the previous question, explain the results you obtained by relating all three plots with the inflated heuristic function with the three plots from the previous question. What are the differences between this set of plots and the previous set of plots? Explain your answer.






Here in the first 2 graphs, after taking 2*h in the heuristic function, the graphs are still similar. Dijkstra is still the same, but for A*, it's expanding the nodes faster than before and that's why it is getting lower running time than before.

However, the solution cost of A* is different and sometimes it's giving the wrong value, but the value is still close to the correct solution cost. Sometimes A* is overestimating the solution cost. It's overestimating when the heuristic's estimate is higher than the actual final cost. Which

means the algorithm is no longer have an admissible heuristic. So, the algorithm can end up exploring the paths that it should be ignoring and finding suboptimal paths. In the solution cost graph, plots are not in the line, and more particularly plots shifted toward A* from the line. That indicates that A* is overstating the solution cost.