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ASEN 5519

Homework #6

**Exercise 1**

1. Path plots

Workspace #1

Chart, histogram, box and whisker chart

Description automatically generated

Workspace #2

Chart

Description automatically generated

Path Length Workspace #1: 19.750

Path Length Workspace #2: 45.250

1. I would expect the path length to be smaller for Workspace #2 but NOT Workspace #1. The reason for this is that no matter how small we make our grid size, in Workspace 1 the distance to goal will always be the total Manhattan distance to goal. This is not the case in Workspace # 2 because we have to “wind” around the obstacle and as the grid size decreases, so will the total displacement along the y direction. NOTE: I am ignoring the small changes in distance that may occur at the end of the path due **only** to the change in grid size. Otherwise, I would expect Workspace #1 path to increase in length slightly and Workspace #2 would still decrease in length.

1. The wavefront planner is far more reliable than the gradient descent planner as it is complete with respect to the grid resolutions. I was not able to generate a path to goal for Workspace #2 using the gradient descent planner from HW5, but the wavefront planner was able to find a path easily without having to tune obstacle/goal parameters.

**Exercise 2**

Workspace #1

C-space

Chart

Description automatically generated

Snapshots

Chart, line chart

Description automatically generatedChart, line chart

Description automatically generatedChart, line chart

Description automatically generatedChart, line chart

Description automatically generated

Workspace #2

C-space

Chart, surface chart

Description automatically generated

Chart, box and whisker chart

Description automatically generatedChart, line chart

Description automatically generatedSnapshots

Chart, line chart

Description automatically generatedChart, box and whisker chart

Description automatically generatedChart, line chart

Description automatically generatedChart, line chart

Description automatically generated

Workspace #3

C-space

A picture containing chart

Description automatically generated

Snapshots

Chart, box and whisker chart

Description automatically generatedChart, line chart

Description automatically generatedChart, line chart

Description automatically generatedChart, line chart

Description automatically generatedChart, line chart

Description automatically generatedChart, line chart, box and whisker chart

Description automatically generatedChart, line chart

Description automatically generatedChart, line chart, box and whisker chart

Description automatically generatedChart, line chart

Description automatically generatedChart, box and whisker chart

Description automatically generated

**Exercise 3**

1. A\* implementation:
   1. Path: 0→2→9→13
   2. Path Length: 5
   3. Number of Iterations: 9
2. To turn the A\* algorithm into Dijkstra’s you have to stop using the heuristic and we do not sort the O list. Instead of picking the node with the smallest f (which would now equal g) value in the O list, we just pick the first node of the O list. This is called breadth first search because we look at the subsequent layers of nodes from each node.
3. Dijkstra’s implementation:
   1. Path: 0→2→7→13
   2. Path Length: 5
   3. Number of Iterations: 13
4. A\* performed better than Dijkstra’s in that it found the goal in less iterations. If I was equipped with a good heuristic (admissible) I would choose A\* to search a large map from start to goal and from start to any node in V.
5. I used an adjacency matrix to represent my graph. If I were to implement an undirected graph I would make the adjacency matrix *symmetric*. The A\* algorithm implemented in this assignment would be able to run over this graph still.