# AE 5222 – Optimal Control of Dynamical Systems

## Homework Submission Cover Page and Statement of Academic Honesty

I, John O'Neill, submit the solution to Homework Problem 7.

My signature below affirms that all of the writing in this submission is my own work. Any reference material that I used to prepare this submission, including text or video resources, but excluding the lecture notes and videos provided on the Canvas site for this course, is properly cited.

To prepare this submission:

■ I verbally collaborated with the following individuals (excluding *Piazza* discussions):

Currently enrolled in AE 5222: Evan Kelly

Not currently enrolled in AE 5222: __________

☐ I did not verbally collaborate with any other individual.

This submission reflects my individual effort and my own understanding of the course content.

I have read and I understand WPI's Academic Honesty Policy, and my conduct in preparing this submission has been in accordance with this Policy.

**Signature:** __________ **Date:** 04/21/2019

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Homework 7

Method

For this problem I used the Dijkstra's algorithm function written by Joseph Kirk which can be found at https://bit.ly/2Zzu1uG. I modified it slightly in order to be able to access the number of iterations for which the algorithm executed.

To complete this task I first needed to create an adjacency matrix of the graph, defining adjacency as the nodes to the right, left, above, or below any given node. Next I created n edge matrix which contains a pair of nodes that form an edge, along with that edge's respective cost which was calculated using the cost function defined in `hw2_2017_main.m`.

I could then input this edge cost matrix to Dijkstra's algorithm along with the desired start node of 1 and end node of $N^2_G$. This would output the optimal path, its total cost, and the number of iterations taken to find this optimal path. The results given different values of $N_G$ are shown below.

Results

For $N_G$ = 3, the following results are shown:

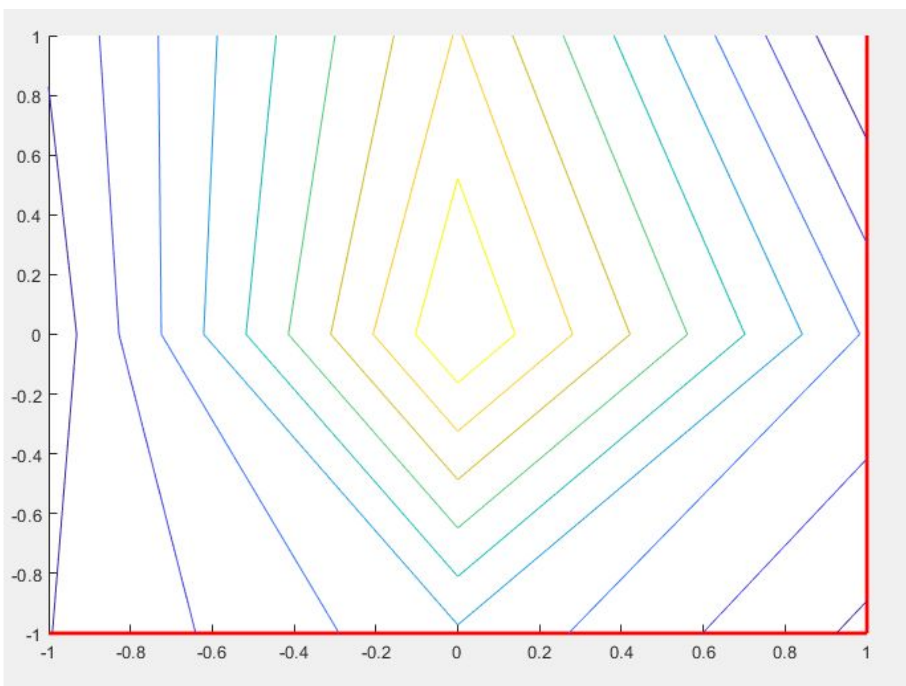


Figure 1: Optimal path for $N_G$ = 3

For N_G = 3, the path cost = 12.609, and number of iterations = 9.

For $N_G$ = 15, the following results are shown:

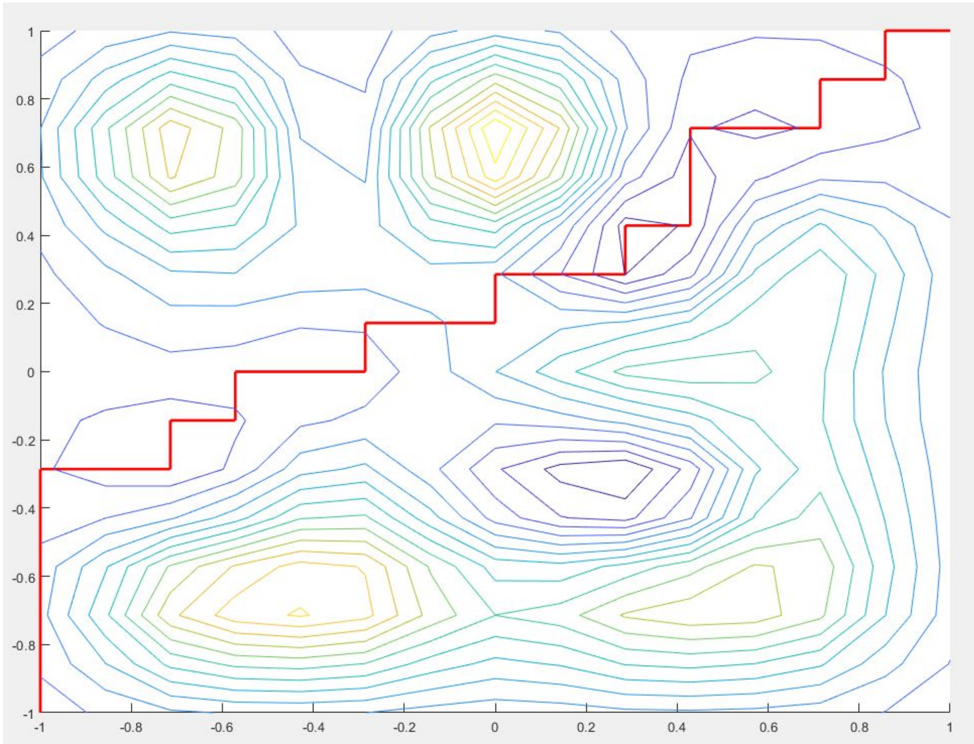


Figure 2: Optimal path for $N_G$ = 15

For N_G = 15, the path cost = 80.559, and number of iterations = 225.

For $N_G$ = 101, the following results are shown:

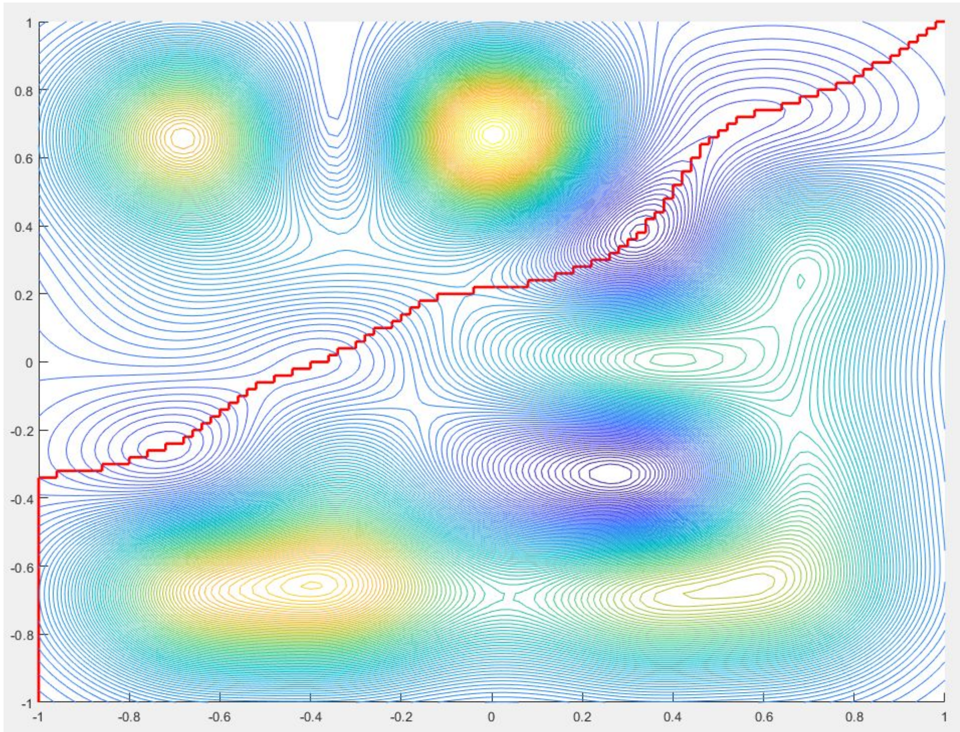


Figure 3: Optimal path for $N_G$ = 101

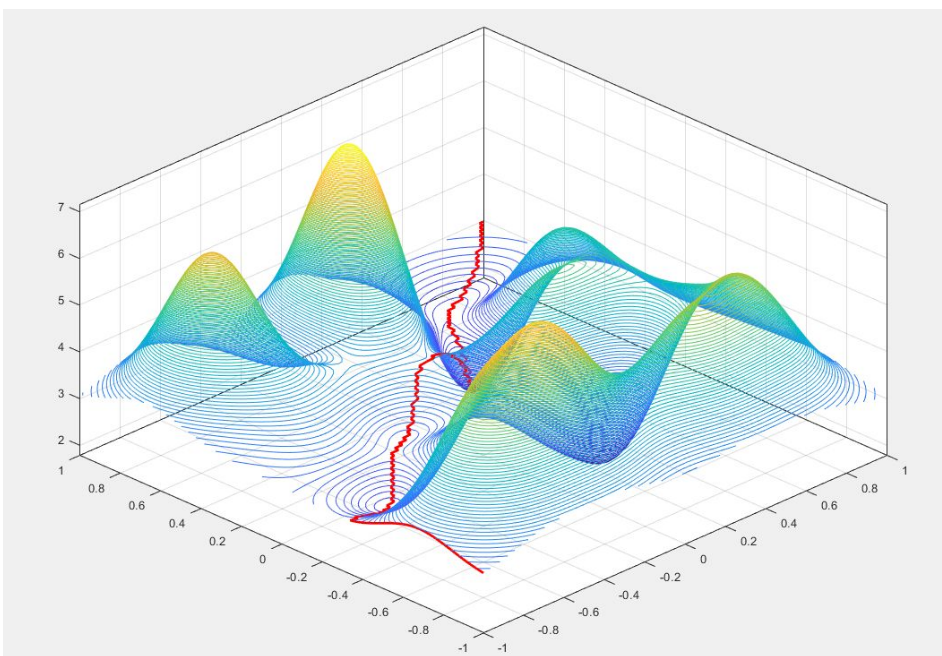

Figure 4: Another visualization of the optimal path for $N_G$ = 101

For N_G = 101, the path cost = 566.013, and number of iterations = 10201.

## Discussion

The optimal paths calculated in Matlab are visually apparent that their total costs are minimized. The results therefore confirm the correct determination of the adjacency matrix as well as the correct operation of Dijkstra’s algorithm.