Homework 2 – Motion Planning – Hari Sudan Sundar

Points to Note:

1. This executable was built with Visual Studio 2013 and Multi-Threaded (/MT).
2. The version of Mujoco.exe (server) is probably the old version, since this version was downloaded on 05/18. The server used is also attached in the zip for reference.
3. The program execution pauses before starting to animate the shortest path for each of the three sources. It waits for a user input "ENTER KEY" to start each animation. And sleep is also introduced for each interpolated step to help you closely track the trajectory.
    a. For example: Before starting animation for each source, it would prompt with the below message and wait for you to press enter key
        i. "Press enter key to do shortest path animation for source: 0"
        ii. "Press enter key to do shortest path animation for source: 1"
        iii. "Press enter key to do shortest path animation for source: 2"
4. The default values for N, K in the program are N = 1000, K = 30. However, you can try other combinations by giving command line parameters, like the following.
    a. For example, to start it with N = 2000, K = 50, Results file = results.txt , you would execute
        i. **MujocoClient.exe 2000 50 results.txt**
    b. If you execute just "**MujocoClient.exe**", then default values of N = 1000, K = 30 are used and the results (shortest path distances) are not saved on disk anywhere, nor shown on command line.
    c. **So if you prefer to see the shortest path distance results and with faster completion time, I would encourage you to execute with the following parameters:**
        i. **MujocoClient.exe 1000 30 results.txt** – This would save the shortest path distance results in results.txt for each of the three sources.
5. Dijkstra's algorithm was used to find shortest paths.

Best Shortest Path distance achieved during experimentation with various values of N, K is the below

For N = 10000, K = 200:

Shortest Path Distance for Qinit0 = 2.04932

Shortest Path Distance for Qinit1 = 2.22834

Shortest Path Distance for Qinit2 = 2.39185

The next page gives the complete table of shortest path distances for different values of N, K for each source.

Analysis of shortest path distances based on the values observed in the next page:

As is expected, as we increase N and K, since the number of sampled points and number of possible neighbor transitions increase, graph becomes more dense and hence, the shortest path distances decrease, since we find more alternative routes with lesser cost to reach the goal. But as seen from the table next page, if we keep the number of samples N as constant and keep increasing only the K, though the shortest path distances reduces for the first few K increments, it tops out and doesn't reduce further even if we keep increasing the value of K for the same N. For example, for N = 1000, shortest path distance does reduce when we increase K from 10 to 80 but however for K = 80, 100, 150, the program gives the same shortest path distances and does not get better. However, if the number of samples N is increased and as well as K is increased at-least logarithmically compared to N, we do notice good decrease in shortest path distances. For example with increase of N to 5000 and K = 80 and N to 10000 and K = 200, we do notice significant reduction in the shortest path distances. This can be explained with the idea that even though we are ready to accept more neighbor transitions, there aren't enough valid samples to take advantage of the increase in K, for constant N.

Shortest Path for Source QINIT 0

N	K	ShortestPath
500	10	3.57594
500	20	3.22691
500	30	3.17514
500	50	2.78686
500	65	2.60875
500	80	2.60875
500	100	2.60875
500	150	2.58725
1000	10	3.48935
1000	20	3.14074
1000	30	2.65053
1000	50	2.65053
1000	65	2.65053
1000	80	2.34539
1000	100	2.34539
1000	150	2.34539
2000	20	2.2379
2000	30	2.2379
2000	50	2.04932
2000	65	2.04932
2000	80	2.04932
2000	100	2.04932
2000	150	2.04932
3000	60	2.04932
5000	80	2.16726
10000	200	2.04932

Shortest Path for Source QINIT 1

N	K	ShortestPath
500	10	3.33553
500	20	2.89125
500	30	2.56383
500	50	2.56383
500	65	2.56383
500	80	2.47142
500	100	2.32563
500	150	2.32563
1000	10	3.13794
1000	20	2.80039
1000	30	2.73594
1000	50	2.57774
1000	65	2.57774
1000	80	2.44528
1000	100	2.44528
1000	150	2.44528
2000	20	2.54061
2000	30	2.54061
2000	50	2.54061
2000	65	2.54061
2000	80	2.5066
2000	100	2.47877
2000	150	2.29094
3000	60	2.51677
5000	80	2.42809
10000	200	2.22834

Shortest Path for Source QINIT 2

N	K	ShortestPath
500	10	4.91619
500	20	3.41754
500	30	3.1986
500	50	3.1986
500	65	3.1986
500	80	3.1986
500	100	3.1986
500	150	3.1986
1000	10	4.54298
1000	20	4.07567
1000	30	3.89869
1000	50	3.1986
1000	65	3.1986
1000	80	3.1986
1000	100	3.1986
1000	150	3.1986
2000	20	3.65201
2000	30	3.65201
2000	50	3.49323
2000	65	3.49323
2000	80	3.37786
2000	100	3.1986
2000	150	3.1986
3000	60	3.2218
5000	80	2.75961
10000	200	2.39185