16-811 Homework 4 Resubmit

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Q6:

(a).

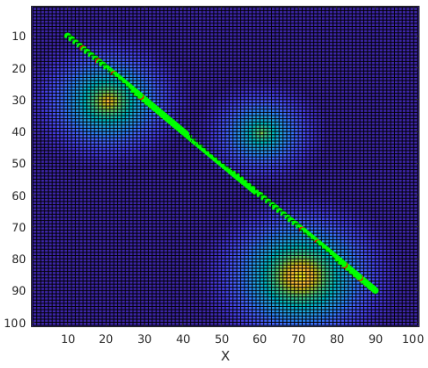

Figure 1: After one iteration

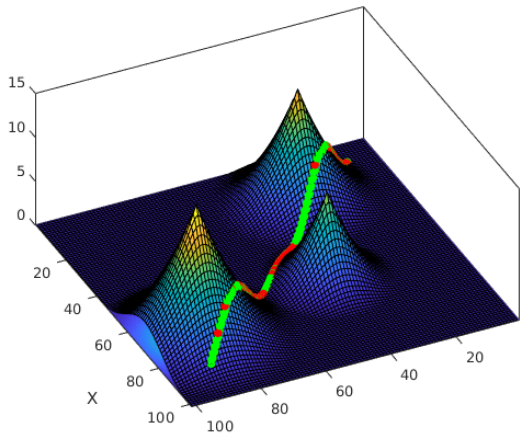

Figure 2: After one iteration

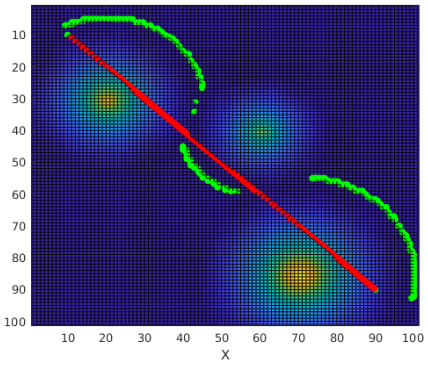

Figure 3: Until convergence

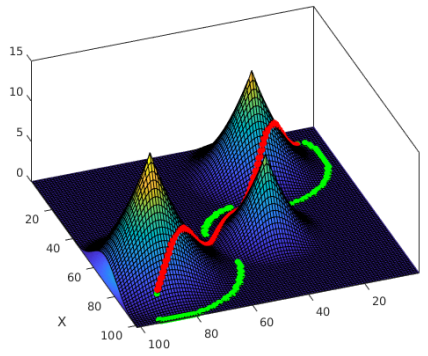

Figure 4: Until convergence

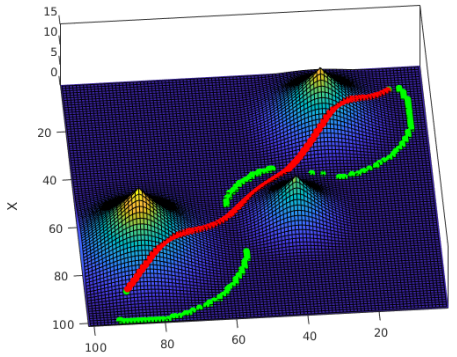

Figure 5: Until convergence

From the figure above showing the new path obtained until gradient descent converged, we can observe that all the points of the path lie in the low cost regions. Also, the path is broken up into several segments, this is because there is no bond connection between each individual point of the path. Therefore, every point tend

to get closer to the direction with steepest gradient descent, and finally gather together at local minimas near them.

(b).

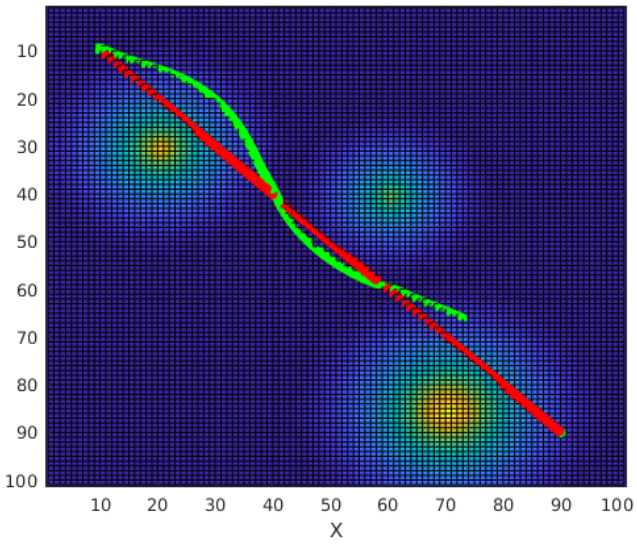

Figure 6: 100 iterations

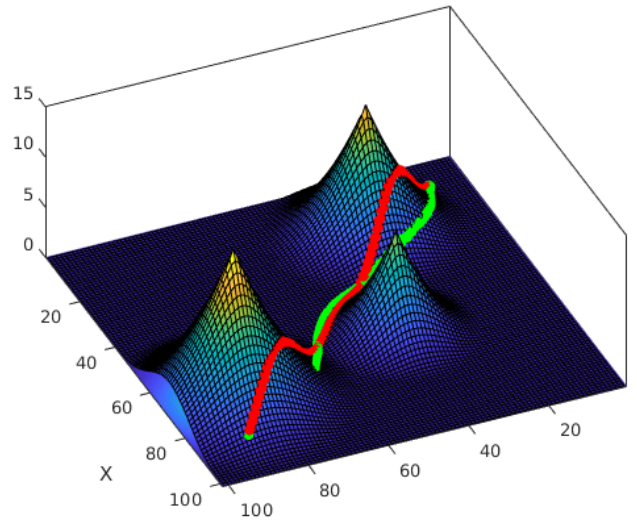

Figure 7: 100 iterations

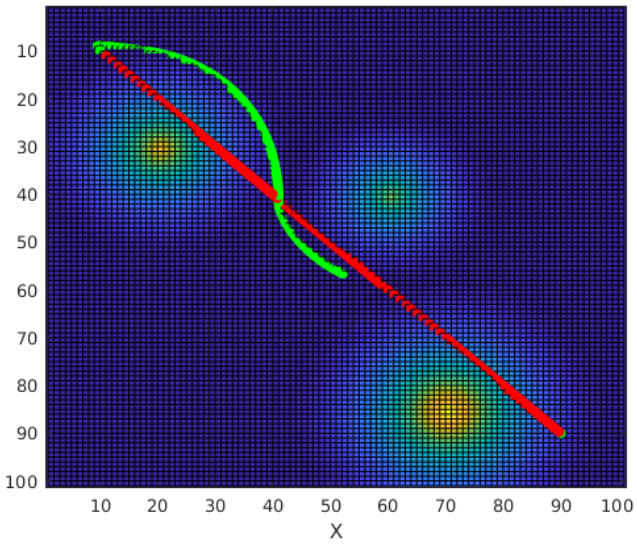

Figure 8: 200 iterations

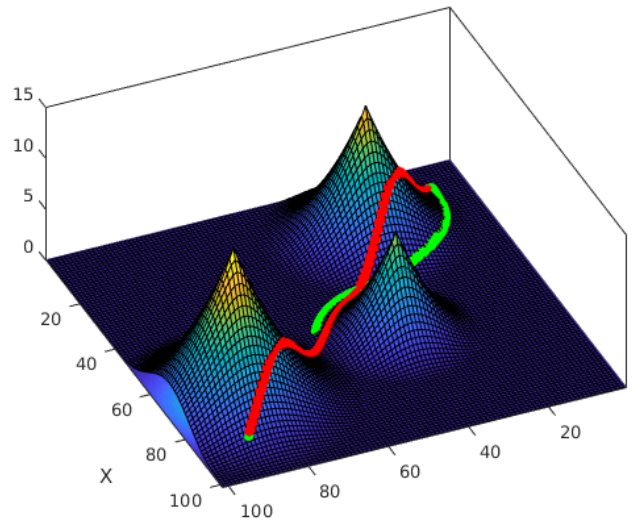

Figure 9: 200 iterations

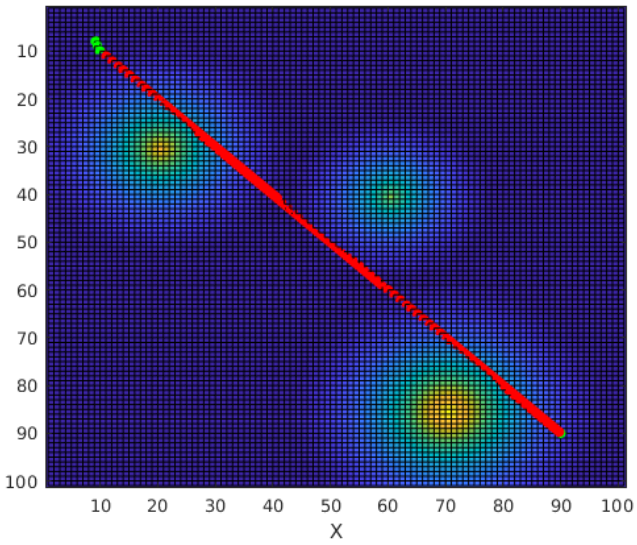

Figure 10: 500 iterations

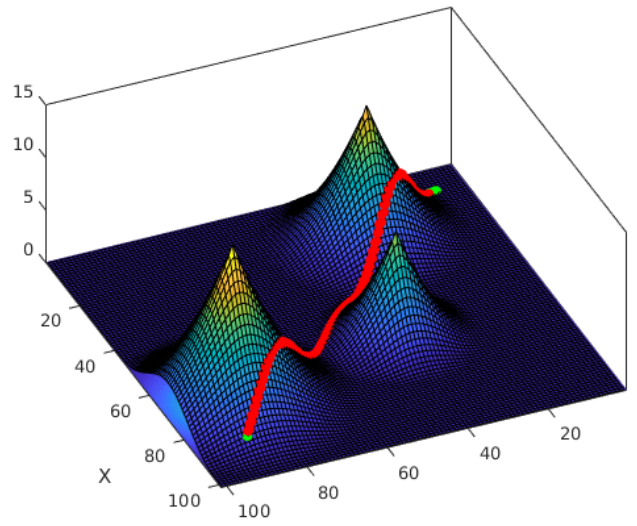

Figure 11: 500 iterations

This does not work because as the number of iterations increases, all the points tend to converge to the point with lowest cost. In this particular case, they all shrinks forward along the original path.

(c).

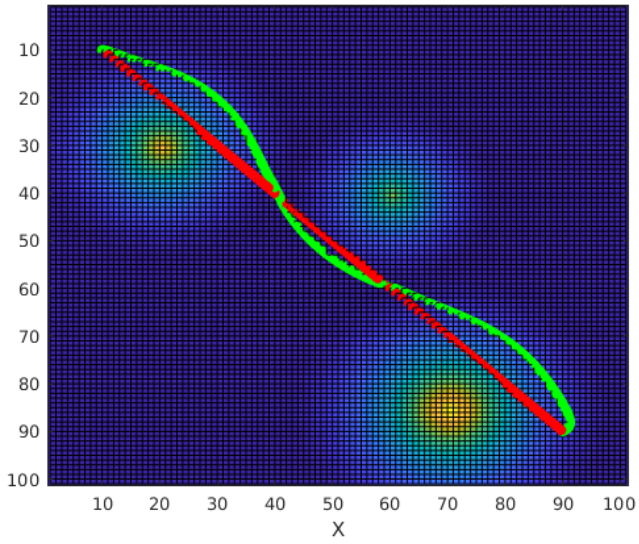

Figure 12: 100 iterations

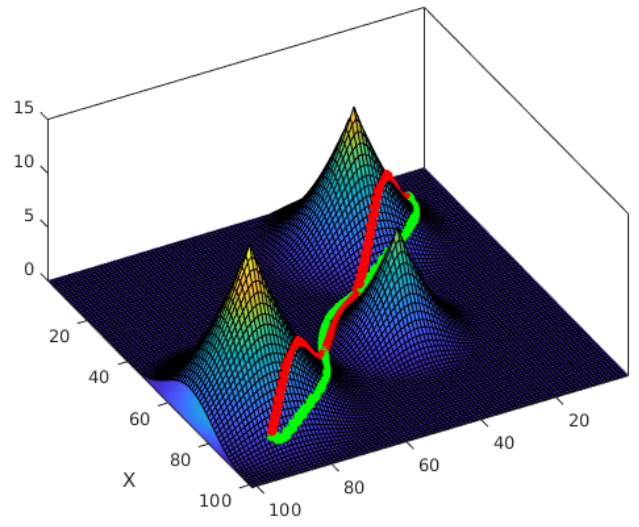

Figure 13: 100 iterations

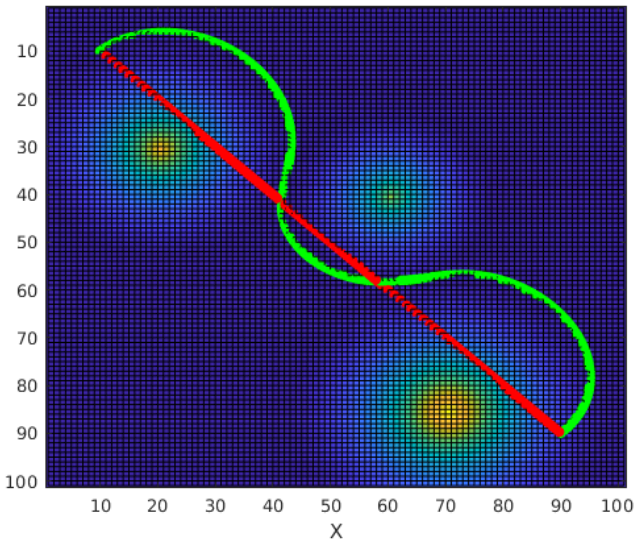

Figure 14: 5000 iterations

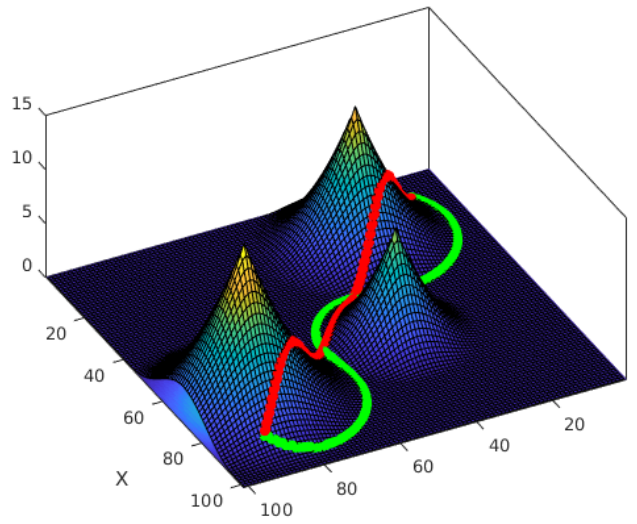

Figure 15: 5000 iterations

(d).

No, it will not be the same every time. The reason is that for this particular environment, the cost map has several local minimas. Therefore, for each different initial trajectory, the gradient direction at each point might be different. Therefore, with the iterations of steepest gradient descent, the points along different trajectories may fall into different local minimas.

(e).

One possible solution is to perform a local gradient descent optimization again for those invalid points, but without considering the smoothness constraint. However, this might result in disconnect / discontinuous points, then we can do interpolation to connect them with nearest points on the trajectory. We can even perform this process with several iterations.