5.8.1: Testing the LQR Controller

The image below shows the costs obtained for the different test cases.

```
Running cartpole with diffferent initializations....
case 0 average cost: 5.5783478153945625
case 1 average cost: 156.17228849905902
case 2 average cost: 677.1143587502311
case 3 average cost: 1861.1390485090335
case 4 average cost: 4474.619593930774
case 5 average cost: inf
case 6 average cost: inf
case 7 average cost: inf
```

Looking at the test.py file, we can see that each case differs from the others in the initial angle of the pole, which increases as the test case index grows. Now, our cost function "penalizes" for large deviations from the ideal position, which has the pole completely vertical, so its angle is 0, which is to say that the larger the angle, the larger the cost. Therefore, the cost at initial time steps will be much larger for those cases with larger initial angles, since they deviate more from the ideal state, and "stronger" actions will be required, meaning, e.g., larger horizontal forces applied to the sides of the cart, leading to an overall higher cost. I suspect that in the last three cases the initial angle is so large that the system can never reach an equilibrium, or approximate equilibrium, and hence the cost diverges to infinity.

5.9.1: Visualization

Lastly, the image below shows the total cost obtained when generating the visualization.

```
(cs184) santiagoginer@dhcp-10-250-16-154 LQR % python cartpole.py
cost =  6.9729050078790245
```