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Problem Set 1, Task 2

COSC 4368

Mar 1, 2021

Report: Randomized Hill Climbing

Preface and Approach:

I believe the quality of solution is sufficient for the randomized hill climbing. It's streamlined and slightly interactive. This means its incredibly re-usable code if needed for another model.

The solution was primarily enhanced by breaking the Randomized Hill Climbing into three parts, the function generator, the neighborhood generator and the function evaluator. The function evaluator essentially found a minimum in the first neighborhood and used that as new testing points in generating another neighborhood and calling those steps recursively until the function found an optimal minimum—not necessarily the absolute minimum of the function.

Interpretation:

This algorithm is efficient with an $O(n^2)$ time complexity. The impact of the starting points helped identify where the minimum likely is. For instance, for most of the experiments, the solutions found averaged to 30. Therefore, my inference is that there's at least a local minimum at 30 yielded by the function provided. And that of which the coordinates (-0.6, -0.5) give that result. Which also means, the further away my coordinates are from that point, (i.e., comparing run 23 to run 24 as well as run 31 to run 32 in the provided table) the longer it will take to climb to the optimal solution.

A setback to this problem is also the variance parameter z, because in all these runs, 30 was the chosen minimum, so if we picked a point that was even further away, there would need to be more neighborhoods needed to be generated so that the evaluator function can reach that minimum a lot quicker. Therefore, the smaller the variance parameter, the longer the time it will take to find an optimal solution. Such example can be see in run 19, where we only need to calculate 30 neighbors per neighborhood, with a variance of .01, which the model takes 198 neighborhood generations to find the same minimum and relatively same coordinates as run 3, except run 3, has a bigger variance even with the same starting point as run 19, but less solutions to search through.

Overall, I believe this RHC experiment did a good job at finding a minimum but is restricted to just starting points to (-2,2), so for my 33rd run, I used (-10,20) as my starting points and a smaller neighborhood of 20 each, with a bigger variance and a seed of 2. I found that although, a much higher result, this function has another minimum—and it is not more optimal because its higher than the previous minimums the experiment outputted. However, this shows a bit of a downfall to random hill climbing, is that there might be more uphills with other minimums and if our variance, or starting point is off, then that can be a problem with using RHC as an optimal solution finder.