Travelling Salesman Problem

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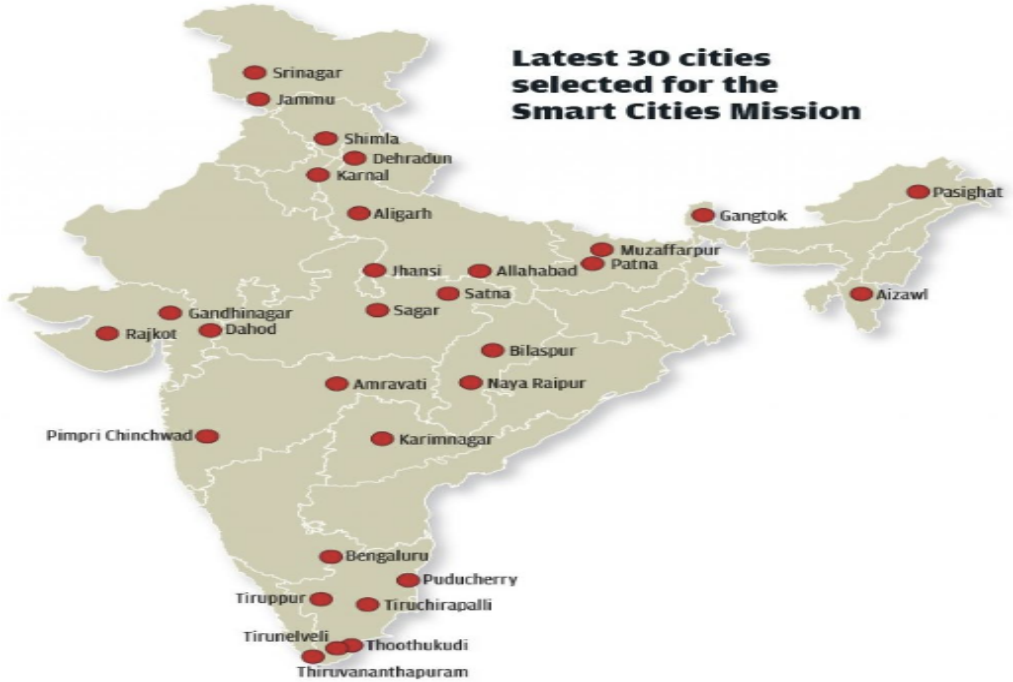
A problem...



Elections are coming! Modi-ji wants to visit all the above cities covered under ”Smart Cities Mission” as a part of his election campaign. Keeping in mind the fact that the elections are in two days, he wants to speed-run through the cities...

Travelling salesman problem

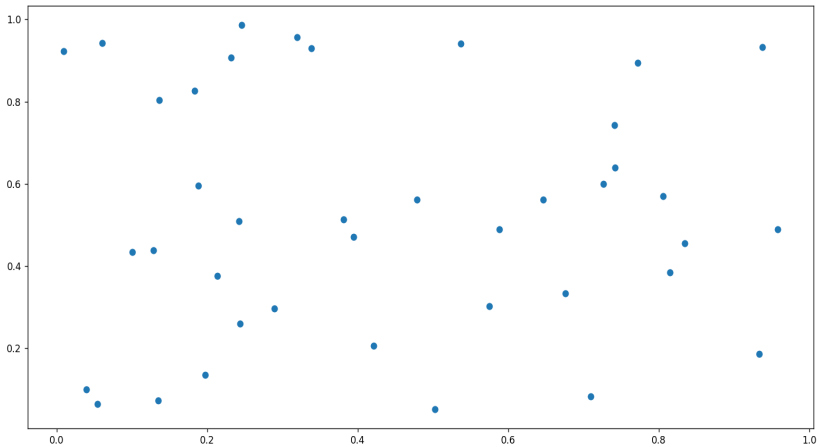


Figure: Cities that need to be covered

Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city exactly once and returns to the origin city?

Other applications

- Maths club project
- In GPS systems
- DNA sequencing
- Global routing (in Circuit Design)

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Objective function is not convex

Approach

Simulated Annealing

Definition

Annealing is a metallurgical process involving the controlled cooling of a heated metal to alter its physical attributes.

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- We simulate this process to apply it to optimizing the TSP
- Instead of always choosing the better path, sometime choose something worse
- Balance Exploration versus Exploitation

Polar Optimization

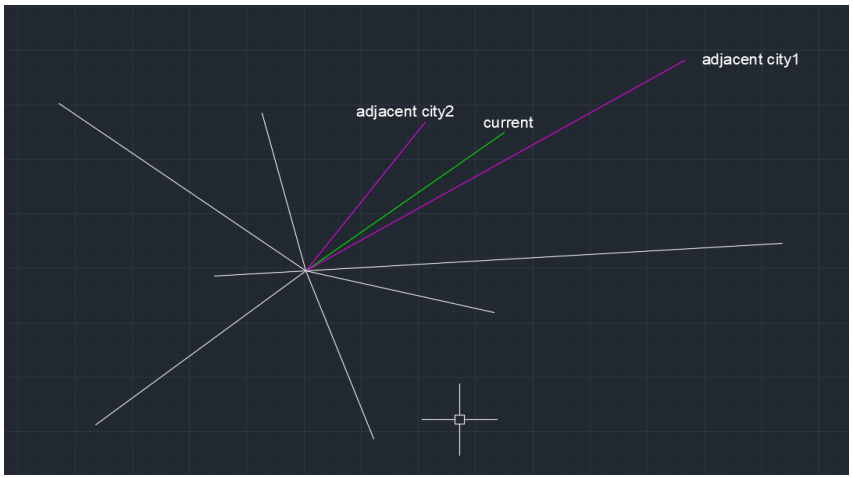

Figure: Implementation of Polar Optimization

- We choose one city as the centroid
- Choose closest cities in terms of angles
- Connect and continue the process
- Connect the final city to the original

Connectivity Swap method

This is what we get ... not so cool!

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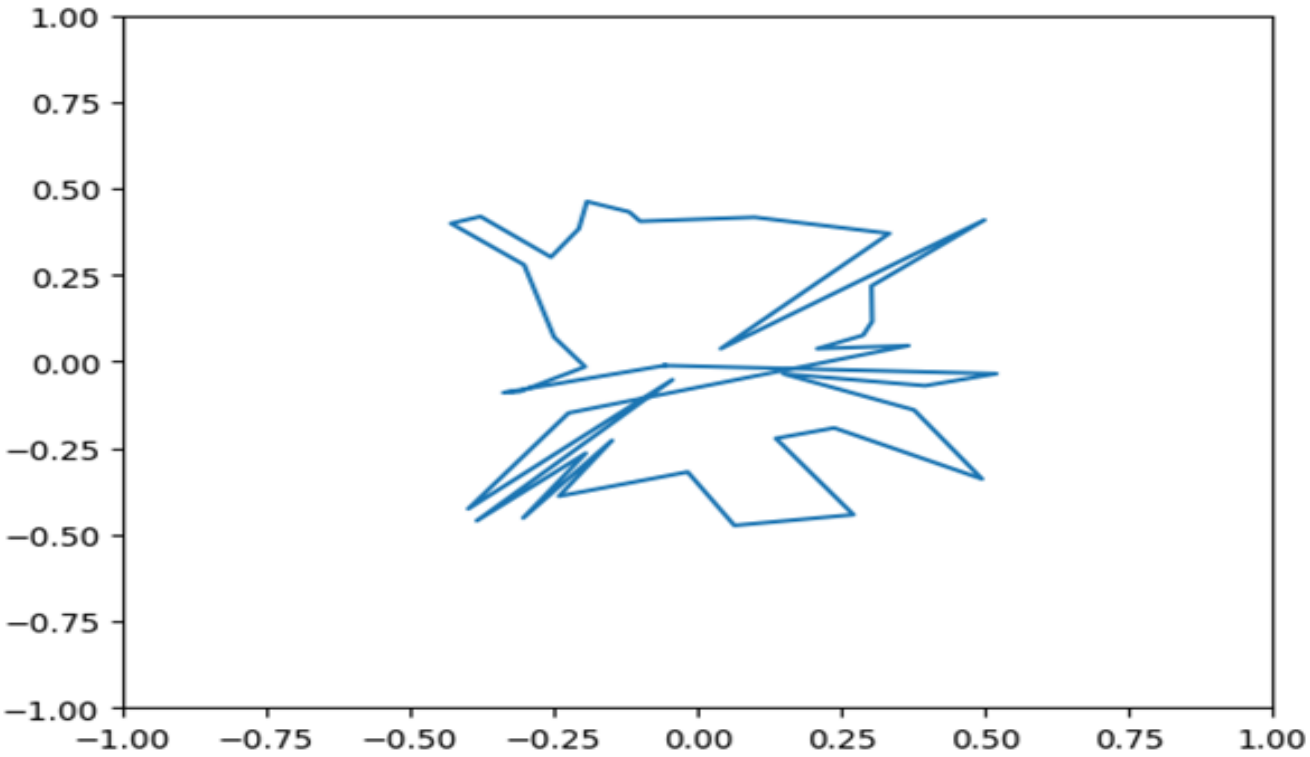
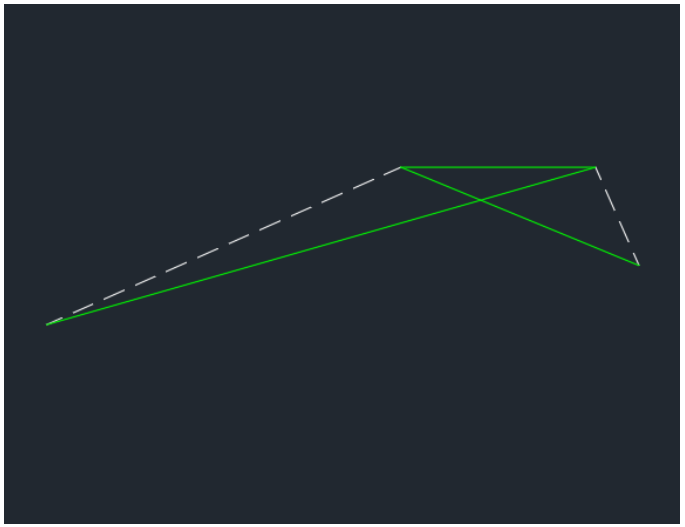


Figure: step1

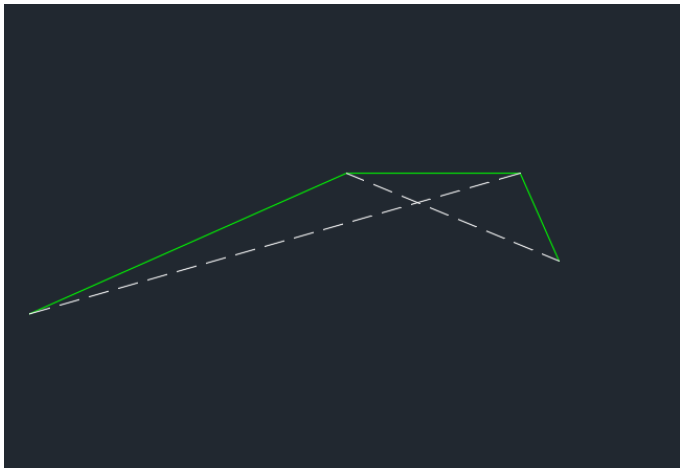
Connectivity Swap method

What about such a pair?

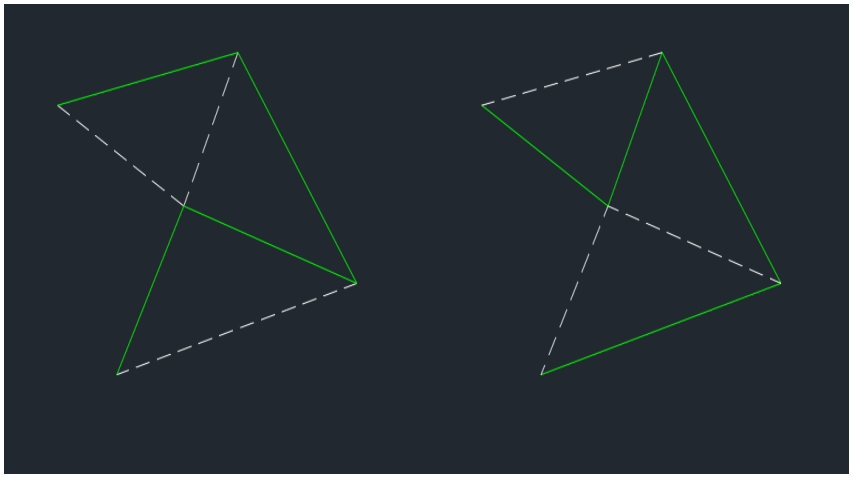


Connectivity Swap method

Idea .. Swap their neighbors!



We might even extend this!



It’s making the figure more ”spread out”

Convex Hull method

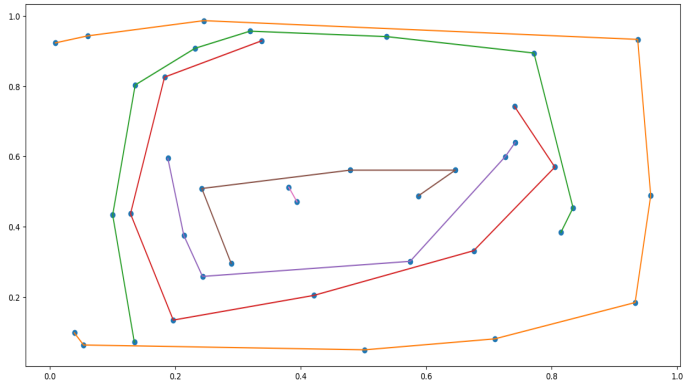


Figure: Implementation of Convex Hull method

- Intuition behind the algorithm is the triangle inequality
- Generate the set of convex hulls and connect them
- Disconnect longest path and connect to adjacent hull

Results of our work

Results of Convex Hull method

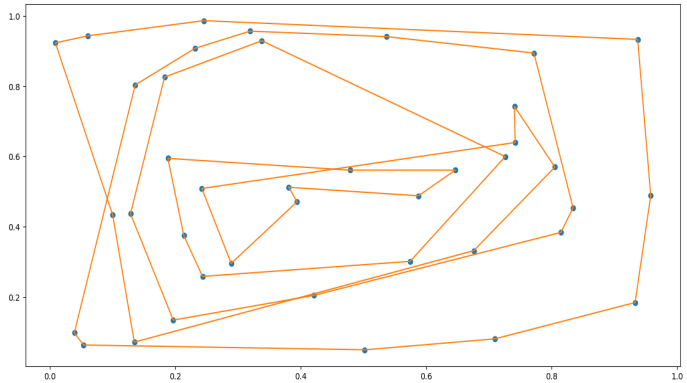


Figure: The result of Convex Hull method

- As the method is simply out of intuition and involves mere connection of convex hull shapes,it has the largest path length of 11.3928
- We can optimize this algorithm by including the solutions found out in polar optimization method

Results of Polar Optimization

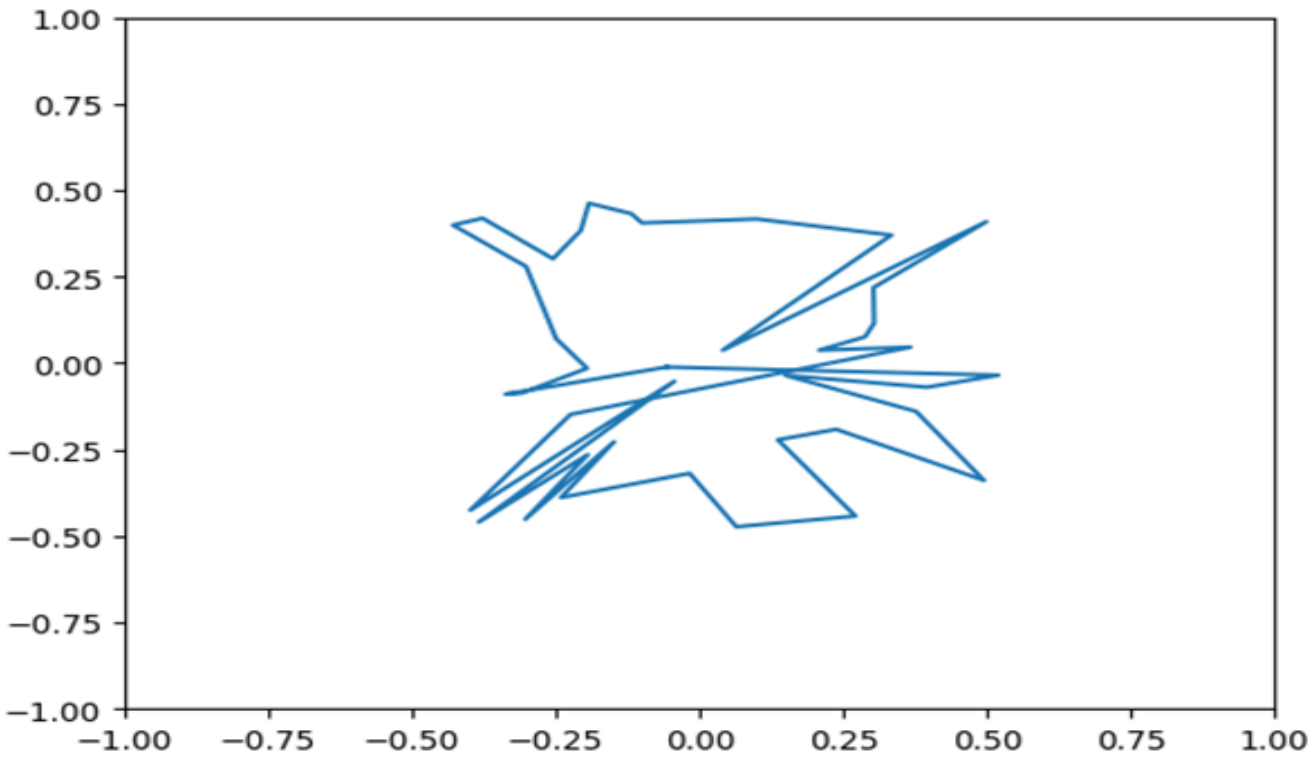


Figure: step1

Results of Polar Optimization

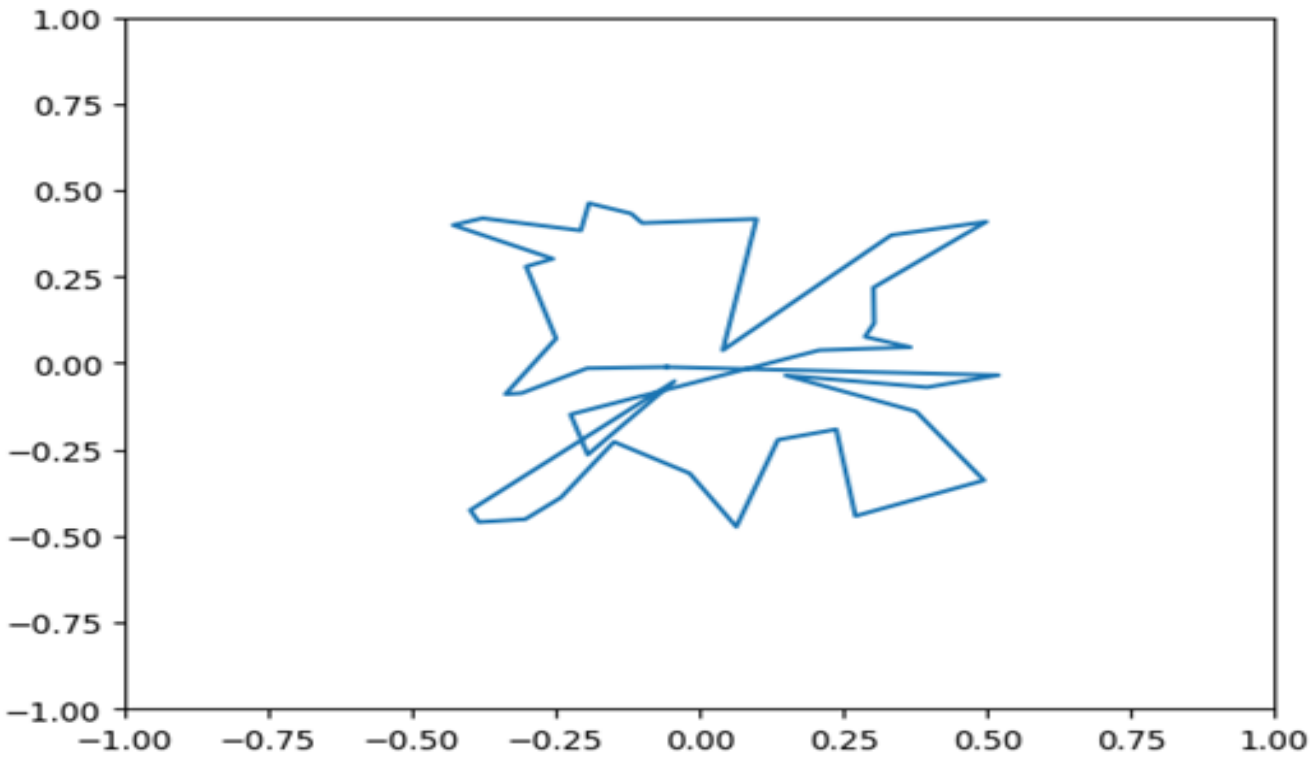


Figure: step2 : the figure is spreading out

Results of Polar Optimization

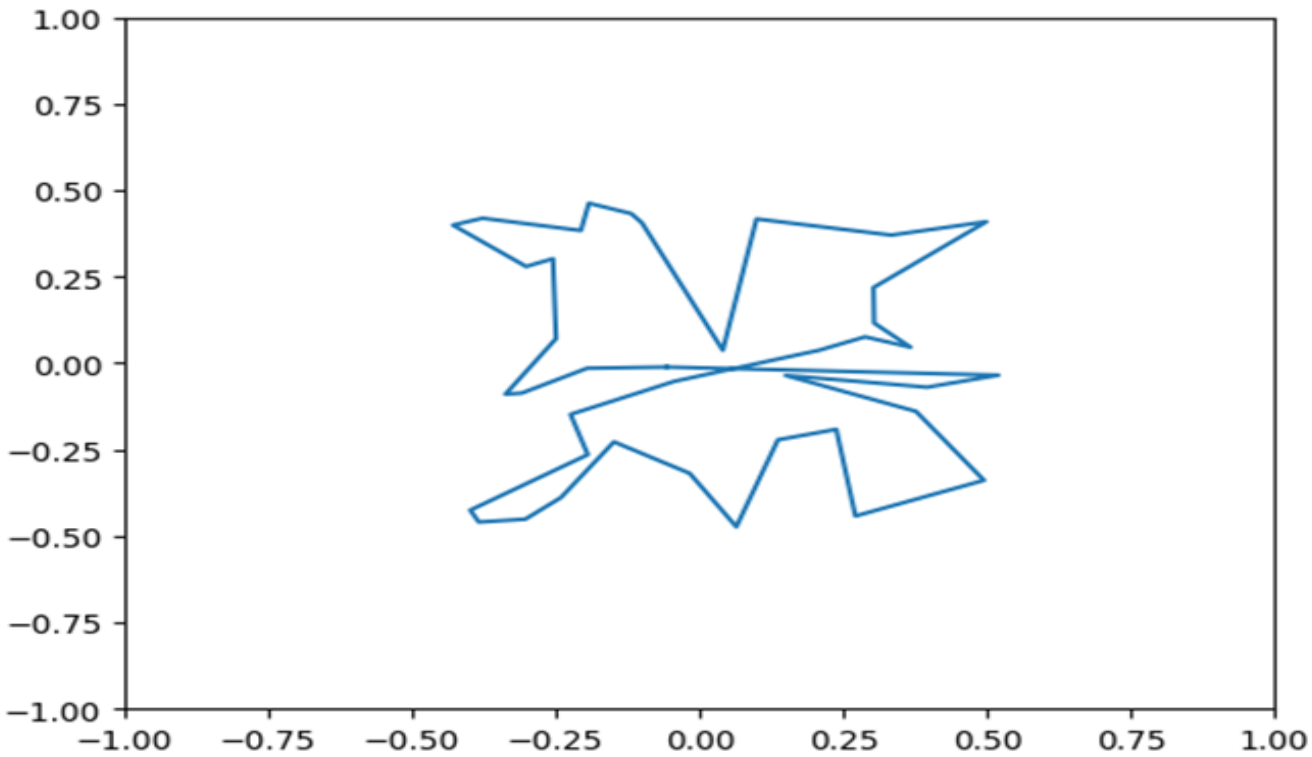


Figure: step3 : the figure is spreading out

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- PS : it runs a lot faster!