Mini Assignment

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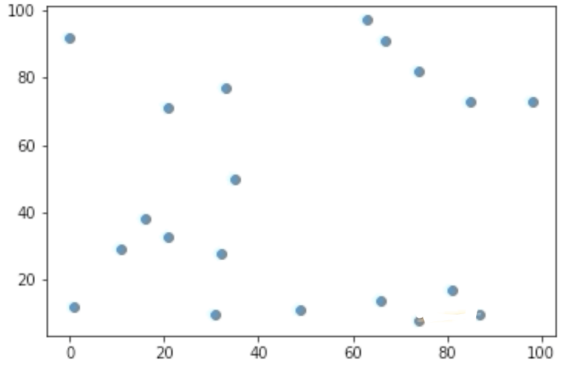
I. THE PROBLEM

Convex Hull is an important geometrical problem that could be solved computationally. A convex hull is the smallest convex polygon containing all the given points. The problem is all about constructing, developing, articulating, circumscribing, or encompassing a given set of points in-plane by a polygonal capsule called a convex polygon. A convex polygon is a simple polygon without any self-intersection in which any line segment between two points on the edges ever goes outside the polygon. Fairly, the convex hull problem is combinatorial in general and an optimization problem in particular.

Suppose we want to solve the problem of this sample application of the given a definite set of points through Convex Hull.

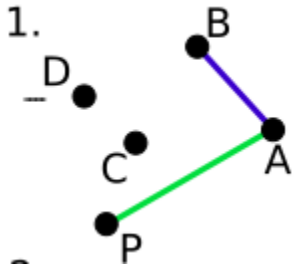


We want to solve this problem by determining and transforming the dot shape of the set of points inside the plane into a Convex Hull.

II. HOW TO GET THE SET OF POINTS

For this section, we will use Graham's Scan. Because it is one of the methods of computing the Convex Hull. We're given a simple example of points such as P-A-B-C-D before we apply the method to the sample application.

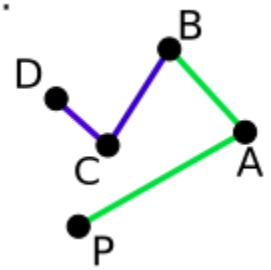
1. Start at a point guaranteed to be on the hull (P). For each point, it is first determined whether traveling from the two points immediately preceding these points constitutes making a left turn or a right turn.



2. If it is a right turn, the second to the last point is not part of the Convex Hulls and rather lies inside it. Since D makes a right turn relative to vector BC, C is not a part of the

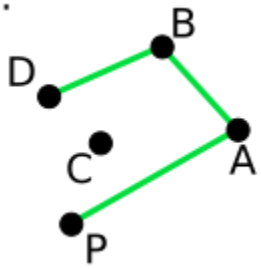
Convex Hull.

2.

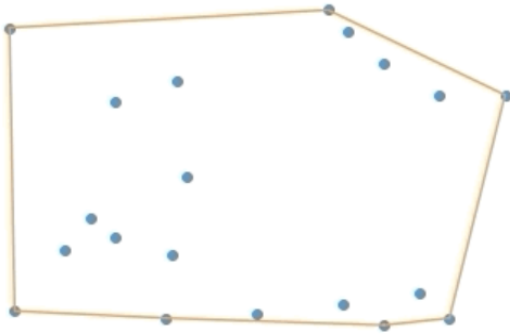


3. Then we compare D with vector BA. Since D makes a left turn relative to vector BA, D is appended to the stack of the Convex Hull.

3.



4. Sort the remaining points by polar angles of vertices relative to the first point (P). and go through sorted points, keeping vertices of points that have left turns and dropping points that have right turns. We apply the step and do this step repeatedly until we find the final dot points and it will be shaped in some sort of a rectangular heptagon shape.



III. WHY SHOULD WE USE A CONVEX HULL TO SOLVE THE PROBLEM?

We use Convex Hull to solve the problem, especially Graham's Scans to find the Convex Polygons that cover all the points inside the plane. Because Graham's Scans is the most efficient algorithm for finding the Convex Hull of a set of points in the plane with time complexity O(N log N).

Graham's Scans find all vertices of the convex hull ordered along its boundary. It uses a stack to detect and remove concavities in the boundary efficiently. Yet this is the example why Graham's Scans is the simplest and efficient way to implement.

VI. REFERENCES

[1] Pandey, D., 2019. Contours and Convex Hull in OpenCV Python. [online] Analytics Vidhya. Available at: <https://medium.com/analytics-vidhya/contours-and-convex-hull-in-opencv-python-d7503f6651bc> [Accessed 24 May 2022].