Comparison of Convex Hull Algorithms

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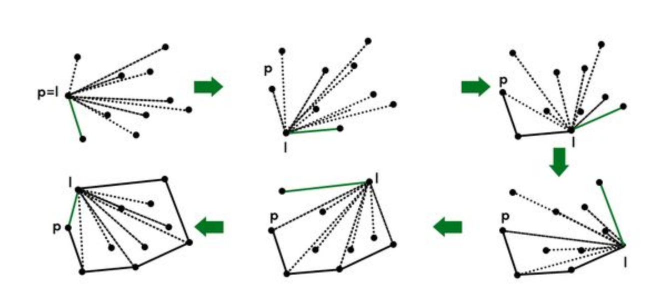
CONVEX HULL

It refers to the smallest convex polygon (or polyhedron in higher dimensions) that encloses a given set of points in Euclidean space to maximize area while minimizing perimeter.

Convex hulls have numerous applications in various fields, such as computational geometry, computer graphics, geographic information systems (GIS), image processing, robotics, and more. They are used to solve problems like finding the smallest enclosing boundary around a set of data points, collision detection in computer games, and routing algorithms in network design. Algorithms like Graham's scan, Quickhull, and the jarvis march are commonly employed to compute the convex hull of a set of points.

JARVIS MARCH

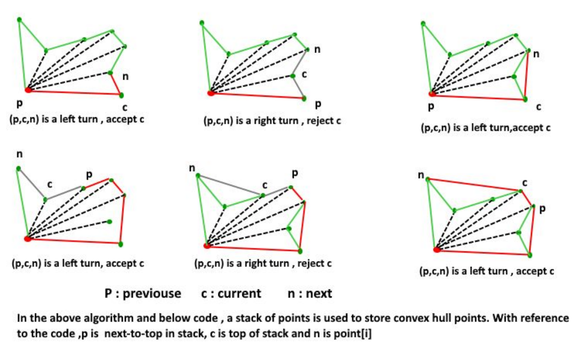
- Start from the point with the lowest y-coordinate
- Select the next point on the convex hull that makes the smallest counterclockwise (left) turn from the current point by iterating through all the points. The point with the smallest angle forms the next edge of the convex hull.
- Repeat step until you return to the starting point.



The execution of Jarvis March

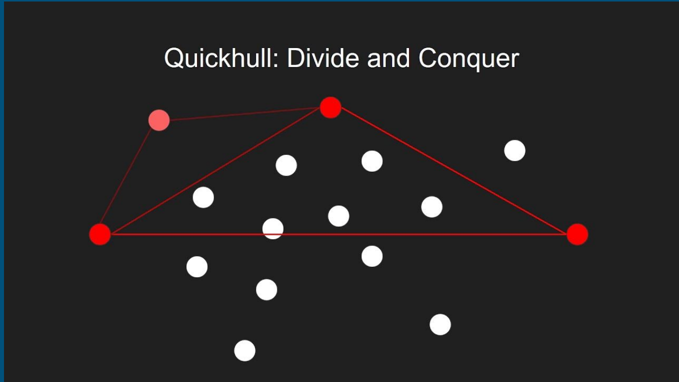
GRAHAM SCAN

- Find the point with the lowest y-coordinate
- Calculate the polar angles of all other points with respect to the pivot point
- Sort the remaining points based on their polar angles in counterclockwise order
- Push the pivot point and the first two points from the sorted list onto the stack
- These three points form the initial hull.Starting with the third point in the sorted list, iterate through all the remaining points.
- If the point makes a left turn, it is part of the convex hull, so push it onto the stack.
- If the point makes a right turn, pop the top point from the stack until a left turn is formed



QUICK HULL

- The Quickhull algorithm is a divide-and-conquer algorithm for finding the convex hull
- Identify the two points with the lowest and highest x-coordinates in the set.
- Divide the remaining points into two subsets: those that are inside the line segment formed by the extreme points and those that are outside. Points inside are "candidates" for inclusion in the convex hull, while points outside are excluded.
- For each of the two subsets created in step 2 (inside and outside points), perform the following steps recursively:
- Find the point in the subset that is farthest from the line segment formed by the extreme points. This point must be part of the convex hull. Add it to the convex hull.
- Split the current subset into two new subsets:
  - One subset contains points inside the triangle formed by the extreme points and the newly added point.
  - The other subset contains points outside this triangle but inside the region defined by the extreme points and the new point.
- Continue this process recursively until you can no longer split the subsets.



COMPARISON OF ALGORITHMS

JARVIS MARCH	GRAHAM SCAN	QUICK HULL
Its working	Its working	Its working
The Jarvis March algorithm is a brute-force approach to finding the convex hull.	The Graham Scan algorithm is a divide-and-conquer method	The Quickhull algorithm uses a divide-and-conquer strategy
Time complexity: O(nh) where h is edges. So worst is O(n^2)	Time complexity of O(n log n)	Time complexity of O(n log n)
Slow for large datasets	It is generally more efficient than Jarvis March but can be slower than Quickhull in certain cases	It is suitable for practical applications when a faster convex hull algorithm is needed.

THANK YOU