

DAA Assignment 2

Area of n- sided polygon
using divide and c

Group member:

Ritu IIB2019025

Athithi IIB2019026

Shahid IIB2019027

Faculty - “DR. Rahul Kala”

Mentor - “Md. Meraz Sir ”



Outline

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Problem Statement

Find area of n- sided polygon using divide and conquer.

So , the problem is that You have been given some coordinates of polygon (Either regular Or irregular) , We need to find out the area enclosed by the polygon using Divide and Conquer Strategy.

Divide And Conquer Algorithm

In **divide-and-conquer** we try to decompose a given problem into two or more similar, but simpler, subproblems, to solve them in turn, and to compose their solutions to find optimal solution of the problem.

So basic idea here are:

Divide: This involves dividing the problem into some sub problem.

Conquer: Sub problem by calling recursively until sub problem solved.

Combine: The Sub problem Solved so that we will get find problem solution

Algorithm For the Problem

As In this Problem ,We need to find the area n sided polygon in which we have been given coordinates of all vertex.

So, overall idea is to divide the problem into two pieces $n/2$, vertex in one and $n/2$ in another, and recursively we calculate area of both section and then add them together to find the area of complete polygon

Steps to follow:

- Divide the n vertex into $n/2$ and $n - n/2$ and recursively call for them.

- Once we find ($n == 2$), We then consider that particular side , so our idea is to take the area to the left of the chosen side, all the way to the Y-axis as shown in fig. That area is shaded grey in fig..So, the grey area is easily calculated as $(X_0 + X_1) / 2$ times $(Y_0 - Y_1)$.
- So We are adding all the area while going down the axis

- Now when we go up the other side of the polygon subtracts all the yellow area shown here, because when a side is going up, $(Y_0 - Y_1)$ will be a negative number. The area that wasn't subtracted (grey) will be our required area of the polygon.
- Also as $(Y_0 - Y_1)$ will be positive or negative depending on the position of vertex therefore we don't need care about where to start.

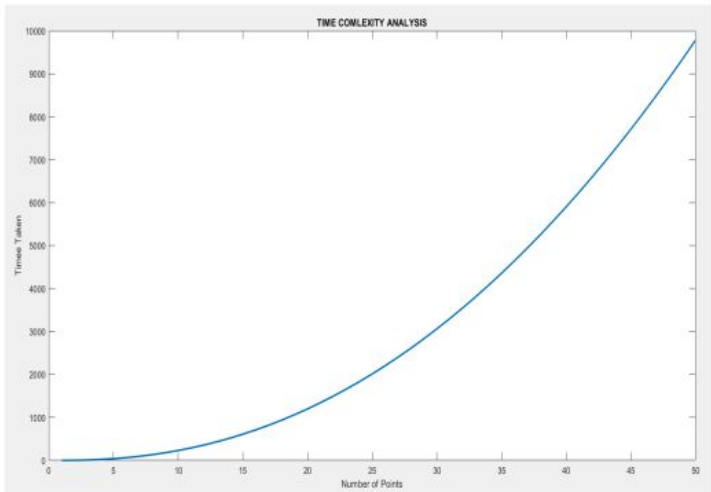
Time Complexity

$$T(n) = 2T(n/2) + O(n) + O(n) + O(n)$$

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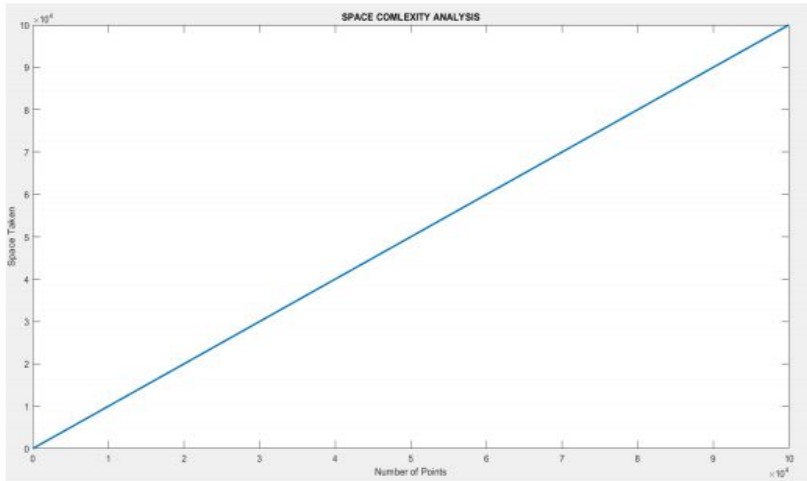
Thus on combining we get the overall time complexity

$$\text{as: } T(n) = T(n \log n)$$



Space complexity

The space complexity of the program is $O(n)$. This is because



Conclusion

- So , overall Conclusion is that we have divided our problems and then for the simplest subproblem we solved the problem and then we merges everything together to get the solution of our original problem.
- we conclude that the time complexity is $O(n \log n)$ and space complexity is $O(N)$.

References:

Divide and conquer algorithm

<https://www.geeksforgeeks.org/divide-and-conquer-algorithm-introduction/>

Shoelace Formula:

https://en.wikipedia.org/wiki/Shoelace_formula

Area of n sided polygon

<https://www.geeksforgeeks.org/area-of-a-polygon-with-given-n-ordered-vertices/>

Thank
you

