

Design And Analysis of Algorithms

Department of Information Technology

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ASSIGNMENT-4 DEMOSTRATION

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OUTLINES

- Introduction and Problem Statement
- Divide and Conquer
- Data Structures Used
- Experimental Analysis
- Conclusion
- References

Problem Statement

“Given an array of n points on 2D plane, find the closest pair of points. ”

An Example

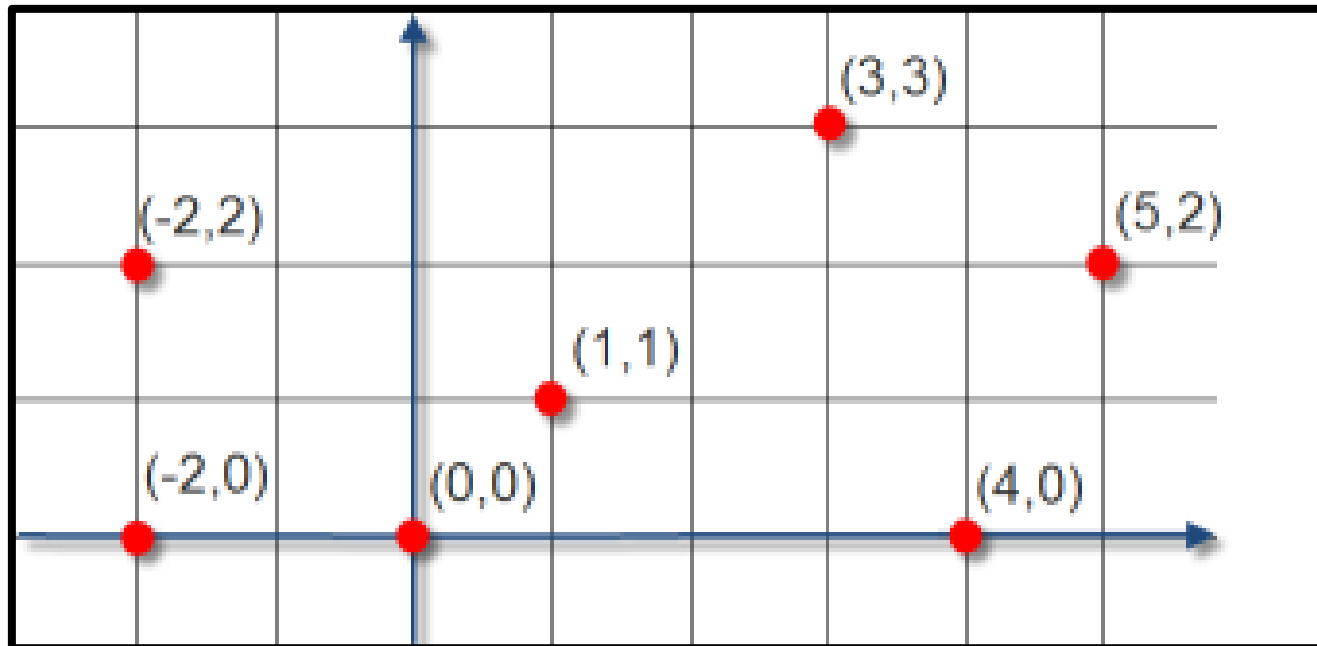


Figure 1: Demonstration of Closest Pair of Points

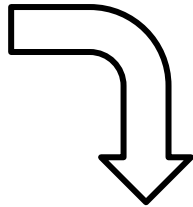
**“Here $(0,0)$ and $(1,1)$ are the closest pair
with distance=1.41 units”**

Divide and Conquer

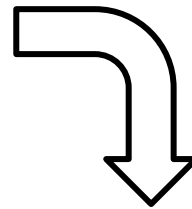
- Divide and Conquer is a Programming Paradigm which recursively breaks down the problem into sub problem and finds the required answer by making decisions on the answers found for those sub-problems.
- This technique has a wide variety of uses. Binary Search and Merge Sort are some such example.

Algorithm

Input set of points



Algorithm based on
Divide and Conquer



Output the closest pair

Algorithmic Steps

1. Create two extra arrays and sort them according to X and Y co-ordinates respectively.
2. Keep on dividing and calculate the answer for sub-problems.
3. Combine the answer of those sub-problems to get the answer for the bigger one.(Finding the closest point's pair in entire plane).
4. Print the required closest point's distance

A Clear View

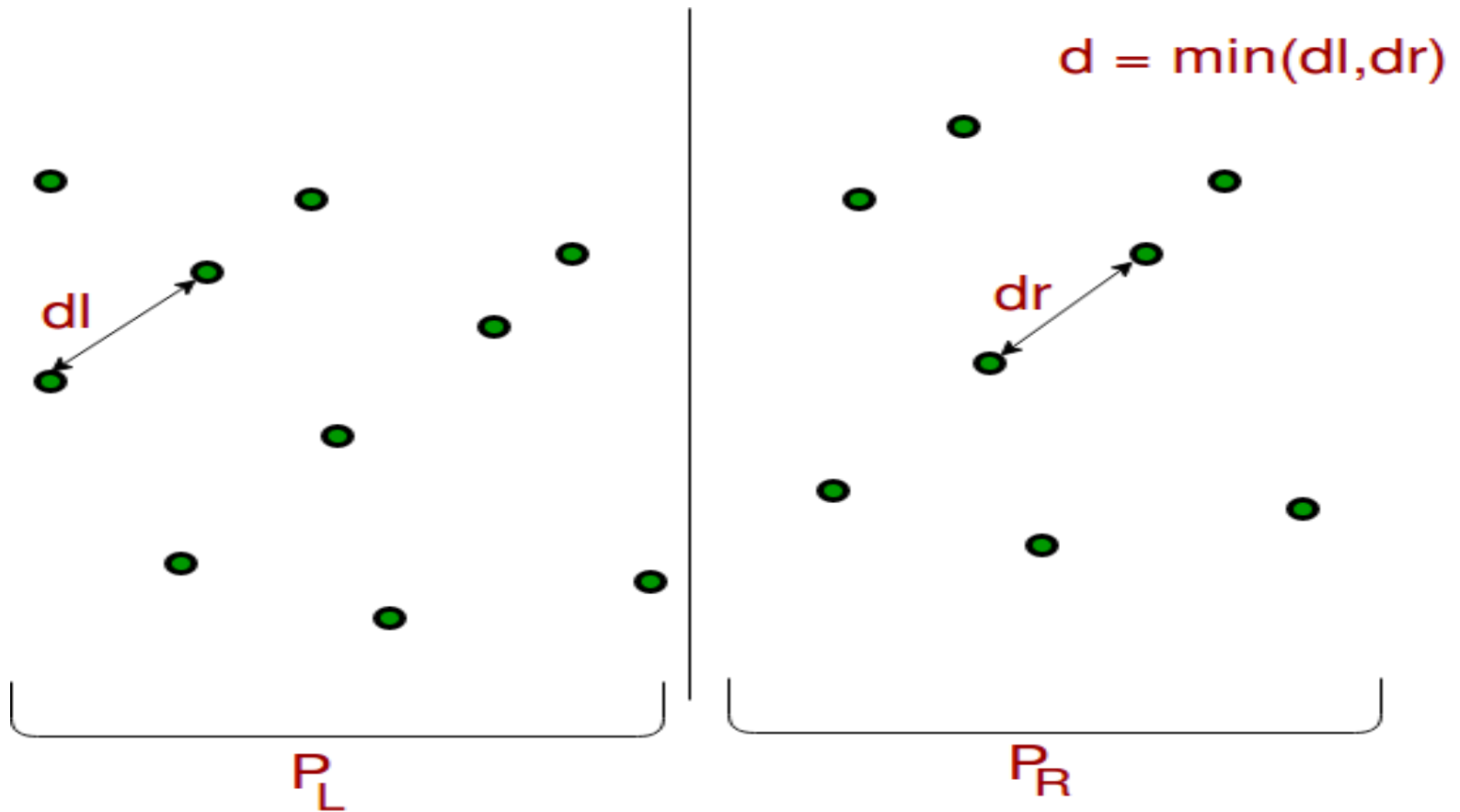


Figure 2: Divide and Conquer Clear View

Time Analysis

$O(n \log n)$

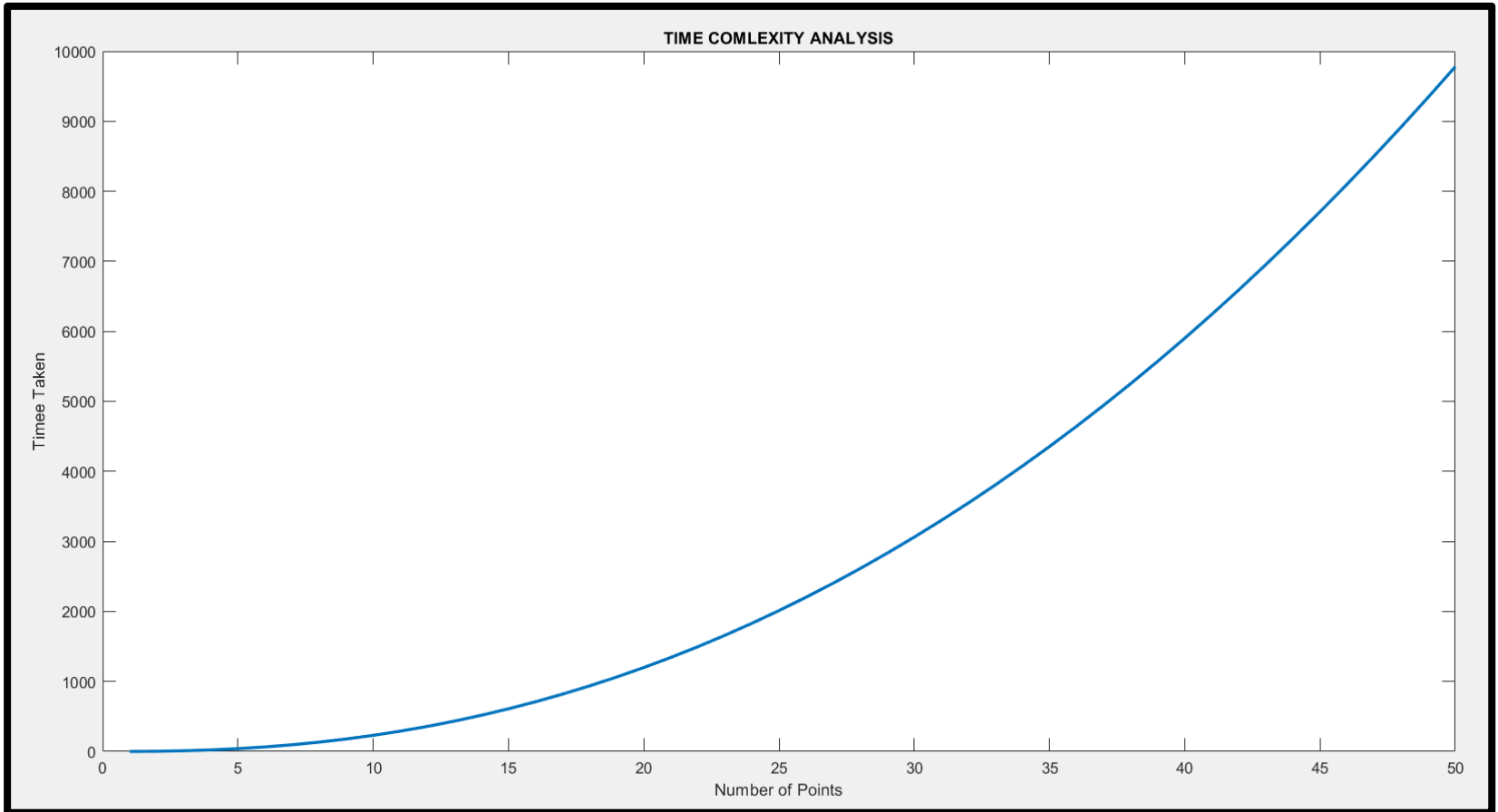


Figure 3: Time Analysis

Space Analysis

$O(n)$

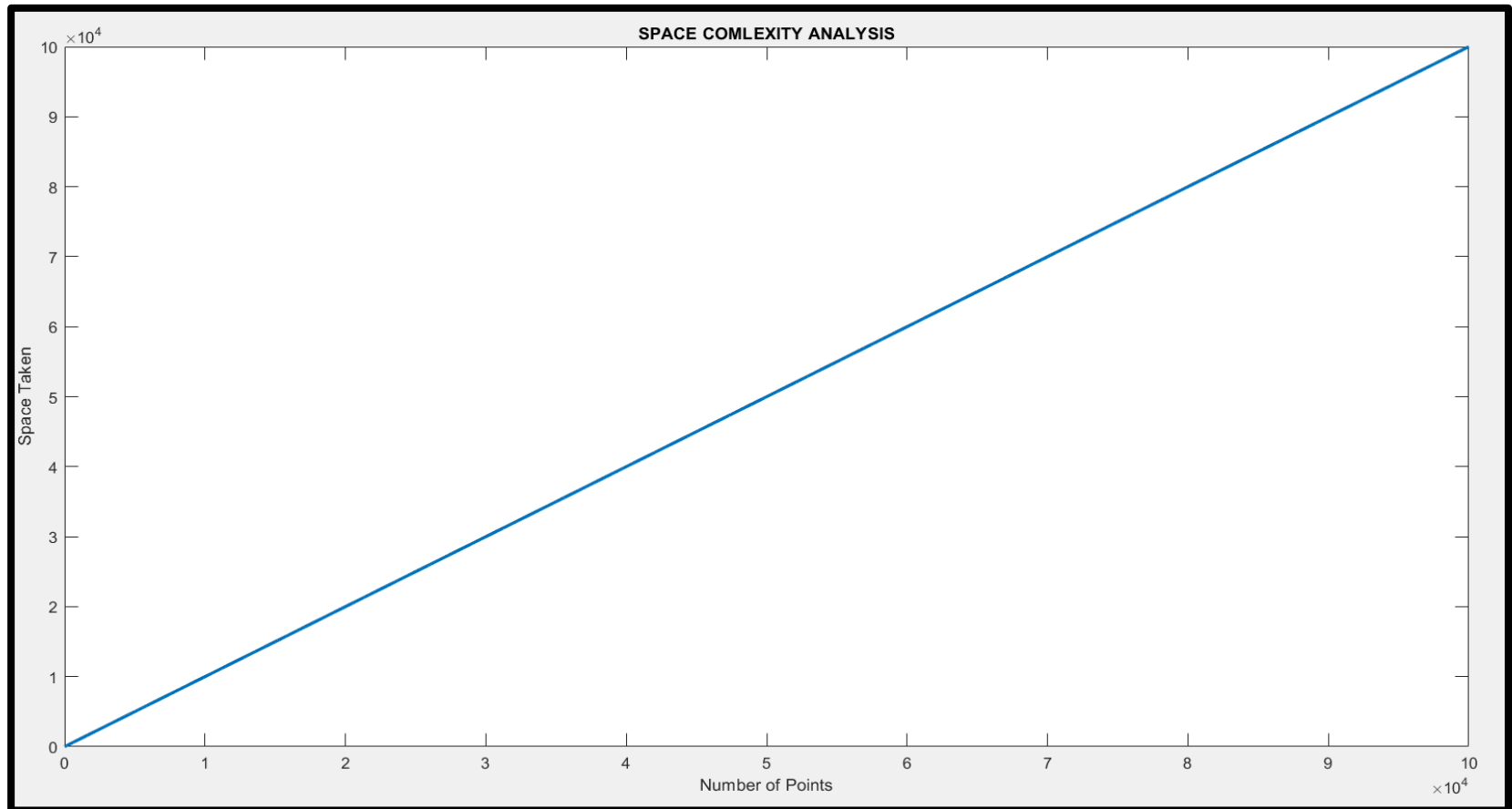


Figure 4: Space Analysis

Applications

There are so many applications of Divide and Conquer:

1. Binary Search
2. Merge Sort
3. Quick Sort
4. Segment Trees
5. Strassen's Algorithm

Conclusion

- In this presentation, we have discussed the method based on Divide and Conquer to find the closest pair of points.
- Experimental Studies show that the optimal time complexity is $O(n \log n)$ and space complexity is $O(n)$.
- Divide and Conquer has a wide variety of Uses and scope as discussed earlier.

References

1. Introduction to Divide and Conquer
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3. Introduction to Algorithms by Cormen, Charles, Rivest and Stein.
<https://web.ist.utl.pt/fabio.ferreira/material/asa>
4. Demostartion of Closest pair Points
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- 5 Divide and Conquer for Closest pair of Points
<https://media.geeksforgeeks.org/wp-content/uploads/mindis.png>

THANK YOU !!