

Minimum Difference

DAA ASSIGNMENT- 2

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Problem Definition:-

The given problem here is to find the minimum absolute difference in an array of integers. While the solution to this problem is straightforward on its own, we find the difference between all possible combinations of numbers and keep track of the minimum value, we find that the solution takes $O(n^2)$ time to solve. For large files, the running time of the algorithm becomes unacceptable.

In a sorted array, the algorithm just has to check the difference between the adjacent elements, and keep track of the minimum value, because the adjacent values are the ones closest to each other in value.

Approach to Problem:-

The main problem in this function is to presort the array. We know that the Min Diff function on a sorted array has a running time complexity $O(n)$. So if the running time complexity of the sort is $O(f(n))$, the overall running time becomes $O(\max(n, f(n)))$.

We know that the average case time complexity of any sort is $O(n \log_2 n)$, or higher, the overall time complexity is the same as that of the sort.

To demonstrate this, I have used Selection Sort, which has a time complexity of $O(n^2)$, and Quick Sort, which on average has a time complexity of $O(n \log_2 n)$, on the average. I have compared both with the Brute Force approach, and the results of all the three timing graphs are shown below.

Assumptions:-

The primary assumption is that the inputted values are all integers within the 4 byte range. Another assumption made is that the expected

minimum difference is the absolute minimum difference, i.e., the difference has to be a positive value.

Learning:-

The importance of increasing the time efficiency is clearly highlighted in this project. Even on modern, high powered processors, an algorithm with a $O(n^2)$ time complexity can take hours to process large input files, while $O(n \log_2 n)$ takes mere minutes to complete the same job.

Graphs:-

- Note that the values for Brute Force might have been affected by CPU Overheating issues.
- The Quick Sort time is so low that it becomes a straight line on the Y Axis in this graph.





