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Program: FindClosestPoints.java

To find theoretical worst-case running time this algorithm needs to be split up into three separate parts: quick sort, merge sort, and finding closest pair.

Quick sort theoretical worst case happens when one of the two subarrays are empty and the size of the other array is 1 less than the size of the subarray being partitioned. This forms , which makes C­worst(n) ε Θ(n2).

Merge sort theoretical worst case can be found from

The 2C(n/2) comes from the recursive call in the to separate the points, while the n-1 comes from the merging back together. Using the master theorem Cworst = n\*logn – n -1 ε Θ(n logn)

The closet pair theoretical worst case can be found using the master theorem as well. It takes linear time to divide the problem into 2 sub problems and combining giving the following recurrence relation T(n) = 2T(n/2) + f(n), if n = 2k. f(n) ∈Θ(n2). This means t(n) εΘ(nlogn).

Due to Quick sort having a worst case of Θ(n2). This algorithm will run at a **C(n) εΘ(n^2)**.

The following is the basic operation count for the algorithm. The number of points is the input size. The basic operations for each algorithm were counted, along with array copies that were needed for those operations.

|  |  |
| --- | --- |
| points | basic operation count |
| 4 | 40 |
| 5 | 51 |
| 6 | 66 |
| 8 | 126 |
| 12 | 190 |
| 16 | 295 |
| 20 | 393 |
| 26 | 575 |
| 30 | 711 |

Graphing the count results and applying a line a best fit proves that the class of efficiency is εΘ(n^2).