

Closest-Pair Report

*Amanda Sauerberg-Hansen, Kamila Garczyńska, Nedas Šurkus, Niclas Abelsen,
Tomas Babkine-Di Caprio*

September 22th, 2022

Results

Our implementation produces the expected results for all input files except for some minor differences from Thore's output. These small differences can be attributed to our use of Python which handles floats and doubles differently than other programming languages. This causes small differences in the rounding of distances between points.

Implementation details

Our solution runs in $O(n \log n)$ where n is the number of points. This time complexity is divided as so:

- Constructing P_x , P_y , and sorting. We use the Python `sorted` method which takes $O(n \log n)$ time ([Source](#)). We sort our arrays before the recursion.
- Constructing Q_x , Q_y , R_x , R_y in $O(n)$ time.
- Computing the distance between points near the middle in $O(n)$ time. For the comparison of points we inspect 15 points, as explained (5.10) of Kleinberg and Tardos, Algorithm Design, Addison–Wesley 2008.
- If the amount of P_x is 3 or less, we use a brute force solution to determine the closet pairs. The time complexity of this is $O(n^2)$. As the amount of points is at most 3, the time has no significant influence on the overall time complexity.

We also created the helper functions `record_output` (handles outputting our results to an output file), `calc_distance` (calculates the Euclidean distance between two points), and `read_file` (reads and parses input files). When there are fewer than 4 points, we also find the smallest distance using brute force. This feature is also in it's own function `brute_force`.

How to run our solution

Note: before running tests on all files, delete lines 7 and 8 of `linhp318-tsp.txt`. Or remove the file completely.

1) How to test our solution on a single file:

a) From the terminal, run

```
python3 closest-pair.py <path to data folder>/<name of file>.txt
```

b) Output of the test will be in `data/output.txt`

2) How to run all tests:

The testScript is required to be in the data folder where all the input files are.

a) From the terminal, run the shell script

```
./testScript.sh
```