

## Programming exercise 1

Implement the algorithm of Exercise 4.3 which computes a rectilinear Shortest path tree for a root  $r \in \mathbb{R}^2$  and a set  $T \subset \mathbb{R}^2$  of terminals.

The source code must be written in C or C++ and has to compile with a GNU-compiler (gcc or g++) on linux. You are allowed to use standard headers including the STL.

Your implementation should run in  $\mathcal{O}(|T| \cdot \log(|T|))$  time and has to guarantee an approximation factor of 2 (see Exercise 4.3 b) and d) ). The source-code should be well commented.

**Input** The instance  $T + r$  will be encoded in an input file consisting of  $|T| + 2$  lines.

- The first line consists of the number  $|T|$ .
- Line 2 consists of two integers encoding  $x$ - and  $y$ - coordinate of  $r$  separated by a whitespace.
- All further lines consist of two integers encoding  $x$ - and  $y$ - coordinate of the sinks.

All positions of vertices of the test instances will be integers and all coordinates can be represented as `long int`.

*Example:* The instance with  $r = (-1, -2)$ ,  $T = \{(-2, 1), (0, 2), (2, 0)\}$  would be encoded as follows:

```
3
-1 -2
-2 1
0 2
2 0
```



