Research Institute for Discrete Mathematics Chip Design Summer term 2013

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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 GNUcompiler (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:



Output Let F be the computed Steiner tree. The output should consist of 2|V(F)| lines, where

- The first line encodes c(F) and V(F) (separated by a whitespace).
- Lines 2 to |V(F)| + 1 encode the vertices of F. Give each vertex an index (r should get index zero) and print index, x-coordinate and y-coordinate to encode a vertex (separated by whitespaces).
- Lines |V(F)| + 2 to 2|V(F)| encode the edges. For each edge, print the indices of the vertices contained in it (separated by a whitespace).

Example: The Tree

$$\left(\left\{ (-1, -2), (-2, 1), (0, 2), (2, 0), (0, 0), (-1, 0) \right\}, \\ \left\{ \{ (-1, -2), (-1, 0) \}, \{ (-1, 0), (-2, 1) \}, \{ (-1, 0), (0, 0) \}, \{ (0, 0), (2, 0) \}, \{ (0, 0), (0, 2) \} \right\} \right)$$

can be encoded as follows:



Test instances will be provided on the website of the exercise classes

http://www.or.uni-bonn.de/lectures/ss13/chipss13_ex.html.

(32 points)

The complete source code should be sent by e-mail to *rotter@or.uni-bonn.de* until *Thursday, June 6th.*