Circular arc spline approximation of pointwise curves for use in the NC programing.

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Context.

Shapes used in the NC (numerical control) machine processing are created with lines and circular arcs. Often as a result of the high accuracy approximation of splines by CAD(computer aided design) systems, sets of thousands to millions of consequent points are generated, which result in huge NC programs, impossible for interpolation by the CNC (Computer numerical control) controllers of most machines.

Problem.

A sequence of N (N>500) points is given (X,Y:real). The points are connected in a polyline.

A new curve must be created from arcs and lines, such that:

- It passes through/nearby the given points in the same sequence.
- The distance from the new to the old curve does not exceed a given value E.
- It is composed of minimal number of elements.

Remarks.

1. Lines and Circular arcs should be used.

2. Local minimum - fitting an arc to each set of 3 points - is not a solution of the task.

The participants will receive 2D sequences of points, in text format of the type:

x1, y1
x2, y2
x3, y3
...
xN, yN

The output should look like:

L (xx1,yy1) (xx2,yy2)
A (xx2,yy2) (xx3,yy3) (xxc, yyc) +-1
...
Here (xxc, yyc) are the coordinates of the center of the circle;

+1: direction of the arc counterclockwise, -1: direction of the arc clockwise.

The coordinates of the output elements may or may not match those of the input points.
It is permissible to write the output in an SVG file for visualization.

The lengths of the sets will be of the magnitude of thousands of points, which excludes the possibility for bruteforcing.

Example1: E=0.5

0.4,0
5.3,0
9.6,0
10,0.3
10,2.5
10,3.9
9.7,4.0
4.3,4.0
0.2,4.0
0,3.7
0,2.2
0,0.1

Output:

L (0,0) (10,0)
L (10,0) (10,4)
L (10,4) (0,4)
L (0,4) (0,0)

Example 2: 500 points from an ellipse .

References.

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2. Kazimierz Jakubczyk. Approximation of Smooth Planar Curves by Circular Arc Splines. May 30, 2010 (rev. January 28, 2012) http://www.kaj.pr.radom.pl/prace/Biarcs.pdf

3. O. Aichholzer, F. Aurenhammer, T. Hackl, B. J ¨uttler, M. Oberneder, and Z. Sır. Computational and structural advantages of circular boundary representation.
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