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PROJECT MAC

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POLYSEG

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POLYSEG takes as input a list of dotted pairs of numbers. These pairs are assumed to be the co-ordinates of adjacent points along a single closed line. It is further assumed that the x and y co-ordinates of successive points differ by 1, 0, or -1.

The output of POLYSEG is a list of dotted pairs of numbers, representing vertices of a polygonal approximation to the figure whose boundary was input. The scale is increased by a factor of four over that of the output; and the output is in fixed or floating point mode; according to the input.

POLYSEG's algorithm consists of four passes. The first, a smoothing pass, replaces each successive pair of points of the input by the midpoint of the pair. This is done twice. Example:

• Original points

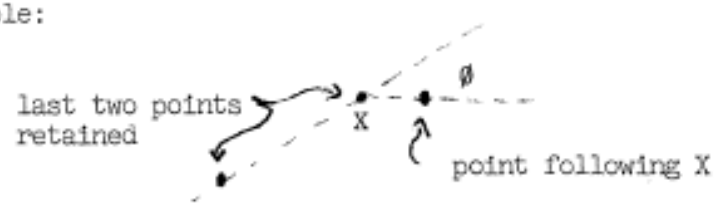
⊙ Midpoints of pairs of •'s

x Midpoints of pairs of ⊙'s

It can be seen that random fluctuations in line direction from point to point are greatly reduced. Corners will remain, slightly rounded.

The second pass eliminates points which are approximately on a line with nearby points of the figure. Points are considered sequentially along the boundary, and are eliminated by one of two criteria. By the first criterion, points are eliminated which are in a line with others close to them in the figure.

Example:



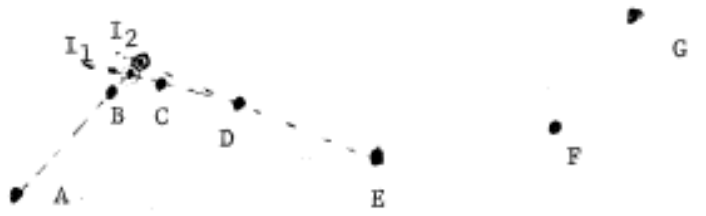
X is eliminated if Ø is below a cutoff value

The cutoff value for Ø is 20°. The second criterion will retain points which might otherwise be eliminated by the first criterion, provided the direction of the line is slowly changing. This is accomplished by summing the (signed) deviations measured in applying the first criterion, and retaining a point if the sum (in absolute value) exceeds 45°. For example, if the boundary is that of a circle, all points might be eliminated by the first criterion. However, the second retains a point about every 30° of arc, thus providing a 12-gon approximation to the circle.

The third pass is exactly like the second, except that the thresholds are lowerer to 10°and 20° respectively. This pass was found necessary in order to eliminate a few points left by the previous pass at minor kinks in an otherwise straight line.

The fourth pass establishes the exact location of sharp corners, where such exist. Consecutive sets of four points, A,B,C, and D, are considered for the possible replacement of B and C by the intersection of AB and CD. Such replacement takes place if this intersection is within 7 units of C or D. (4 units corresponds to the original grid size of the input, i.e., the x and y co-ordinates of successive points of the input boundary differ by 0 or ± 4 units)

Example:



First A, B, C, and D are considered. The intersection, I_1 lies close to C, so it replaces B and C. Next, A, I_1, D, and E are considered. The intersection I_2 is similarly close to I_1, and D, and hence replaces these two. Finally A, I_2, E and F are considered. Since the intersection in question is far from both I_2 and E, the points are not replaced, and I_2, E, F, and G are considered.