Algorithm 54

**APPROXIMATION OF STRAIGHT LINES**

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Author's note:

This routine implements a method described by J. E. Bresenham (1965) for the control of an incremental digital plotter in USASI FORTRAN. A similar algorithm has been published earlier (Stockton, 1963) which is structurally identical to that given here (it produces the same set of increments); this version is simpler and is written to achieve fast execution of the inner loop. No multiplications or divisions are needed.

Consider a Cartesian grid of lines of unit spacing, and a plotter which may plot points only at intersections of the grid lines. Then given two points \((x_1, y_1)\) and \((x_2, y_2)\) on the grid...
the routine supplies a set of increments \((\Delta x_i, \Delta y_i)\) which when added successively to \((x_1, y_1)\) produce an approximation to the straight line joining these two points, and such that no increment is greater than 1 in magnitude. The minimum number of increments is obviously

\[
\max(\text{abs}(x_1 - x_2), \text{abs}(y_1 - y_2))
\]

and in fact this number is supplied.

It can be seen from the above that of the two increments \(\Delta x_i\) and \(\Delta y_i\), one will always be unity (in magnitude) after a call to the routine, and therefore more compact ways of returning the results than that chosen are possible. However, since the purpose of the algorithm is to present a method, and since in most applications it will probably be rewritten in a suitable assembly language or recast in form, it was thought unwise to obscure the basic technique.

To illustrate the choice of points by the algorithm a 'print-plot' produced by a sample driver program is shown in Fig. 1. This consists of the numeral '2' (plotted as five straight-line segments) with various scales and in various orientations.
References:
