Here is a interactive coordinate geometry program for the HP-41CX I wrote sometime in the 1980s.
To run, type in data file name in Alpha register, then press XEQ ALPHA CGX ALPHA

* Number of pts you can store is \( \frac{1}{2} \times \text{length of file} \)
  (e.g. a file sized with 50 regs holds 25 pts.)
  PT numbering starts at 0 (zero).

Menu

<table>
<thead>
<tr>
<th>EA</th>
<th>LN</th>
<th>RS</th>
<th>LS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
</tbody>
</table>

EA \to enter & assign
LN \to lines
RS \to radial stakeout
LS \to list

Entering Bearings: Type in Bearing ENTER

Quad codes are
1 = NE
2 = SE
3 = SW
4 = NW
5 = NA

(Once an azimuth has been entered, the computer will always display azimuths until a bearing is entered, and vice-versa)

Sideshots: Press \( \boxed{\text{mode}} \) to toggle between "sideshot" & "normal" mode. You are in sideshot mode when the little "0" is on the display.

1) when you exit the lines routine, SS mode is turned off.
2) when you restart at a new point, SS mode is turned off
3) In sideshot mode, curves are not computed.
4) When you execute a radial stakeout, SS mode is turned on.
5) You may sideshot intersections.

Curves: To traverse curves, enter the radius point as a negative number. (Notice the little "3" comes on). Traverse or inverse to the radius point, enter the P.O.C. then give either the \( \Delta \) or length. (If the curve turns left, \( \Delta \) and \( L \) are negative values.)

Errors: If you make a serious mistake, or see a message like 'DATA ERROR', press \( \boxed{\text{Esc}} \) to reset the computer and return to the menu.

Abbreviations:

<table>
<thead>
<tr>
<th>ST</th>
<th>PT</th>
<th>NE</th>
<th>NW</th>
<th>NE</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>bearing 1</td>
<td>NW</td>
<td>NE</td>
<td>NE</td>
<td>N0</td>
</tr>
<tr>
<td>B2</td>
<td>bearing 2</td>
<td>SE</td>
<td>SW</td>
<td>SW</td>
<td>N0</td>
</tr>
<tr>
<td>D1</td>
<td>distance 1</td>
<td>AZ</td>
<td>AZ</td>
<td>AZ</td>
<td>N0</td>
</tr>
<tr>
<td>D2</td>
<td>distance 2</td>
<td>PT</td>
<td>PT</td>
<td>PT</td>
<td>N0</td>
</tr>
<tr>
<td>CC</td>
<td>counterclockwise</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>N0</td>
</tr>
<tr>
<td>SH</td>
<td>Short</td>
<td>( \Delta )</td>
<td>( \Delta )</td>
<td>( \Delta )</td>
<td>N0</td>
</tr>
</tbody>
</table>

N0 \to occupied point
DP \to destination point

N \to northing
E \to easting
\( \Delta \) \to Delta
L \to length
<table>
<thead>
<tr>
<th>Registers</th>
<th>Keyboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>04 Current Pt #</td>
<td>A Enter &amp; Assign</td>
</tr>
<tr>
<td>01 Current N</td>
<td>B Lines</td>
</tr>
<tr>
<td>02 Current E</td>
<td>D Radial Stakeout</td>
</tr>
<tr>
<td>03 Brk 1</td>
<td>E List</td>
</tr>
<tr>
<td>04 Brk 2</td>
<td>B Side shot / Normal mode toggle</td>
</tr>
<tr>
<td>05 Dist 1</td>
<td>E Error Reset</td>
</tr>
<tr>
<td>06 Dist 2</td>
<td></td>
</tr>
<tr>
<td>07 Next Pt #</td>
<td>Local Labels</td>
</tr>
<tr>
<td>08 Dest Pt #</td>
<td></td>
</tr>
<tr>
<td>03 Ref Az</td>
<td></td>
</tr>
<tr>
<td>10 Ref Dist</td>
<td>10 Lines Routine</td>
</tr>
<tr>
<td></td>
<td>11 B1 unknown</td>
</tr>
<tr>
<td></td>
<td>12 B1 known, B1 unknown</td>
</tr>
<tr>
<td></td>
<td>13 B1 known, B1 unknown, B2 unknown</td>
</tr>
<tr>
<td></td>
<td>50 Traverse</td>
</tr>
<tr>
<td></td>
<td>80 Store</td>
</tr>
<tr>
<td></td>
<td>20 Traverse</td>
</tr>
<tr>
<td></td>
<td>40 Display</td>
</tr>
<tr>
<td></td>
<td>09 Compute AZIMUTH</td>
</tr>
<tr>
<td></td>
<td>04 A= NW</td>
</tr>
<tr>
<td></td>
<td>02 A= SE</td>
</tr>
<tr>
<td></td>
<td>03 A= SW</td>
</tr>
<tr>
<td>07 =</td>
<td>01 A= NE</td>
</tr>
<tr>
<td>08 =</td>
<td>05 A= NA</td>
</tr>
<tr>
<td>09 Display AZIMUTH</td>
<td>08 Set Data Pointer</td>
</tr>
<tr>
<td>21 Printer on</td>
<td>06 Intersection Setup</td>
</tr>
<tr>
<td>22 Numeric entry</td>
<td>90 Curve</td>
</tr>
<tr>
<td>27 User mode</td>
<td>14 Radial Brk 1</td>
</tr>
<tr>
<td></td>
<td>27 List / Stakeout loop</td>
</tr>
</tbody>
</table>
Formulas

Brg → Az:

Q1: \( Az = Brg \)
Q2: \( Az = 180 + Brg \)
Q3: \( Az = 360 + Brg \)
Q4: \( Az = 270 + Brg \)

Az → Brg:
\( Brg = \frac{1}{2} \arcsin (\sin (Az)) \)

Quad code:
North: \( \cos (Az) = + \)
South: \( \cos (Az) = - \)
West: \( \sin (Az) = - \)
East: \( \sin (Az) = + \)

Traverse, Inverse

\( \phi = Az \) azimuth from 1 to 2

\( \Delta x = d \cos \phi \)
\( d = \sqrt{\Delta x^2 + \Delta y^2} \)
\( \Delta y = d \sin \phi \)
\( \tan \phi = \Delta y / \Delta x \)

Use HP-41 P-R and R-P functions.

\( \Delta x \) \( \Delta y \)

Traverse:
\( N2 = N1 + \Delta N \)
\( E2 = E1 + \Delta E \)

Inverse:
\( \Delta N = N2 - N1 \)
\( \Delta E = E2 - E1 \)
**Bearing - Bearing**

\[
\phi = \text{ref } A_2 \quad c = \text{ref dist.}
\]

\[
\alpha = A_2 - \phi \quad \beta = A_1 - \phi
\]

\[
\gamma = 180 - \alpha + \beta
\]

**Law of Sines:**

\[
a = \frac{c \sin \gamma}{\sin \beta}
\]

\[
\frac{a}{\sin \beta} = \frac{c}{\sin \gamma}
\]

\[
\text{Since } \sin (180 - \theta) = \sin \theta
\]

\[
a = \frac{c \sin \beta}{\sin \gamma} = \frac{c \sin (A_2 - A_1)}{\sin (A_1 + \phi + A_2)}
\]

**Bearing - Distance**

\[
A = \text{ref } A_2 \quad c = \text{ref dist.}
\]

\[
d = \text{known second distance}
\]

\[
\theta = \phi - A_1
\]

\[
a = c \cos \theta
\]

\[
b = c \sin \theta
\]

\[
b = \sqrt{d^2 - h^2}
\]

For long solution use \(a + b\) (cf. 06)

"short" = "a - b" (SE 06)

**Note:** \(\phi\) can be specified as either \(A_2 - \phi\) or \(\phi - A_1\) since the sign of \(\phi\) is unimportant.

Since \(c = c \cos \phi = c \cos (-\phi)\)

and \(d^2 = (c \sin \phi)^2 = (-c \sin (-\phi))^2\)

Also, the sign of \(d\) is unimportant since it is only used as \(d^2 = d^2\)
Distance-Distance

\[ \theta = \text{ref. azimuth}; \quad c = \text{ref. distance} \]
\[ a = \text{known first distance}; \quad b = \text{known second distance} \]

Law of cosines:
\[ b^2 = a^2 + c^2 - 2ac \cos \varphi \]
\[ \varphi = \cos^{-1} \left( \frac{a^2 + c^2 - b^2}{2ac} \right) \]

For clockwise soln. (cf. 06) use: \( A \alpha = \theta - \phi \)
For counterclockwise (cf. 06) use: \( A \alpha = \phi - \theta \)

Curves

\[ A^2 \beta = \Delta + (\alpha \pm 180) \]
\[ L = A \alpha \mp \frac{\Delta N}{\rho} \]

For curves turning to the left: \( \Delta \) or \( L \) is specified as a negative value.
This is a sketch I used during development of the program.