CORDIC to find $\frac{y}{x}$

Q). Let $y = -1$; $x = 5$; Find y/x through CORDIC.

$$x_{i+1} = x_i - \mu d_i 2^{-i} y_i$$
$$y_{i+1} = y_i + d_i 2^{-i} x_i$$
$$z_{i+1} = z_i - d_i e_i$$

→ For Linear rotations

- $\mu = 0$
- $e_i = 2^{-i}$

→ For Linear Rotations:

- $x_{i+1} = x_i$
- $y_{i+1} = y_i + d_i 2^{-i} x_i$
- $z_{i+1} = z_i - d_i 2^{-i}$

Division is computed in vectoring Mode

$\Rightarrow d_i = -sgn(x_i y_i)$

Look up table:

i	0	1	2	3	4	5	6	7	8	9
2^{-i}	1	0.5	0.25	0.125	0.0625	0.03125	0.015625	0.0078125	0.00390625	0.001953125

Step 0 :

- for division set $z_0 = 0$; $x_0 = 5$; $y_0 = -1$.
- $d_0 = -sgn(x_0 y_0) = -sgn(5 \cdot -1) = 1$
  - '-1' of sgn function is encoded as 0 in code.

Step 1

- $x_1 = x_0 = 5$;
- $y_1 = y_0 + (d_0 2^{-0} x_0) = -1 + (1 \times 1 \times 5) = 4$

$\rightarrow z_1 = z_0 - d_0 2^{-0} = 0 - (1 \times 1) = -1$

$\rightarrow d_1 = -sgn(5 \times 4) = -1$

Step 2 :

$\rightarrow x_2 = x_1 = 5$

$\rightarrow y_2 = y_1 + (d_1 2^{-1} x_1) = 4 + \left(-1 \times \frac{1}{2} \times 5\right) = 4 - 2.5 = 1.5$

$\rightarrow z_2 = z_1 - d_1 2^{-1} = -1 - \left(-1 \times \frac{1}{2}\right) = -0.5$

$\rightarrow d_2 = -sgn(5 \times 1.5) = -1$

Step 3 :

$\rightarrow x_3 = x_2 = 5$

$\rightarrow y_3 = y_2 + (d_2 2^{-2} x_2) = 1.5 + \left(\frac{-5}{4}\right) = 0.25$

$\rightarrow z_3 = z_2 - d_2 2^{-2} = -0.5 - \left(\frac{-1}{4}\right) = -0.25$

$\rightarrow d_3 = -sgn(5 \times 0.25) = -1$

Step 4 :

$\rightarrow x_4 = 5$

$\rightarrow y_4 = y_3 + (d_3 2^{-3} x_3) = 0.25 - \left(\frac{x_3}{8}\right) = 0.25 - \left(\frac{5}{8}\right) = -0.375$

$\rightarrow z_4 = z_3 - d_3 2^{-3} = -0.25 - \left(\frac{-1}{8}\right) = -0.125$

$\rightarrow d_4 = -sgn(5 \times -0.375) = 1$

Step 5 :

$\rightarrow x_5 = 5;$

$\rightarrow y_5 = y_4 + (d_4 2^{-4} x_4) = -0.375 + \left(\frac{5}{16}\right) = -0.0625$

$\rightarrow z_5 = z_4 - d_4 2^{-4} = -0.125 - \left(\frac{1}{16}\right) = -0.1875$

$\rightarrow d_5 = -sgn(5 \times -0.0625) = 1$

Step 6:

$\rightarrow x_6 = 5$

$\rightarrow y_6 = y_5 + \left(d_5 2^{-5} x_5\right) = -0.0625 + \left(\frac{5}{32}\right) = 0.09375$

$\rightarrow z_6 = z_5 - d_5 2^{-5} = -0.1875 - \left(\frac{1}{32}\right) = -0.21875$

$\rightarrow d_6 = -\operatorname{sgn}\left(5 \times 0.09375\right) = -1$

Step 7:

$\rightarrow x_7 = x_6 = 5$

$\rightarrow y_7 = y_6 + \left(d_6 2^{-6} x_6\right) = 0.09375 + \left(\frac{-5}{64}\right) = 0.015625$

$\rightarrow z_7 = z_6 - \left(d_6 2^{-6}\right) = -0.21875 - \left(\frac{-1}{64}\right) = -0.203125$

$\rightarrow d_7 = -\operatorname{sgn}\left(5 \times 0.015625\right) = -1$

Step 8

$\rightarrow x_8 = x_7 = 5$

$\rightarrow y_8 = y_7 + \left(d_7 2^{-7} x_7\right) = 0.015625 + \left(\frac{-1 \times 5}{2^7}\right) = -0.0234$

$\rightarrow z_8 = z_7 - \left(d_7 2^{-7}\right) = -0.203125 - \left(\frac{-1}{128}\right) = -0.1953$

$\rightarrow d_8 = -\operatorname{sgn}\left(5 \times -0.0234\right) = 1$

Step 9:

$\rightarrow x_9 = x_8 = 5$

$\rightarrow y_9 = y_8 + \left(d_8 2^{-8} x_8\right) = -0.0234 + \left(\frac{1 \times 5}{2^8}\right) = -0.00388$

$\rightarrow z_9 = z_8 - \left(d_8 2^{-8}\right) = -0.1953 - \left(\frac{1}{256}\right) = -0.199$

$\rightarrow d_9 = -\operatorname{sgn}\left(x_9 \cdot y_9\right) = -\operatorname{sgn}\left(5 \times -0.00388\right) = 1$

Final obtained Result after 10 iterations $= Z_9 = -0.199$

Actual Result $= \frac{-1}{5} = -0.2$

CORDIC PRACTISE DIVISION 2

$$\rightarrow \begin{array}{cccccccccccccccccccc} 19 & 18 & 17 & 16 & 15 & 14 & 13 & 12 & 11 & 10 & 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0. & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ & & & & & & & & & 1 & & & & & & & & & & \end{array}$$