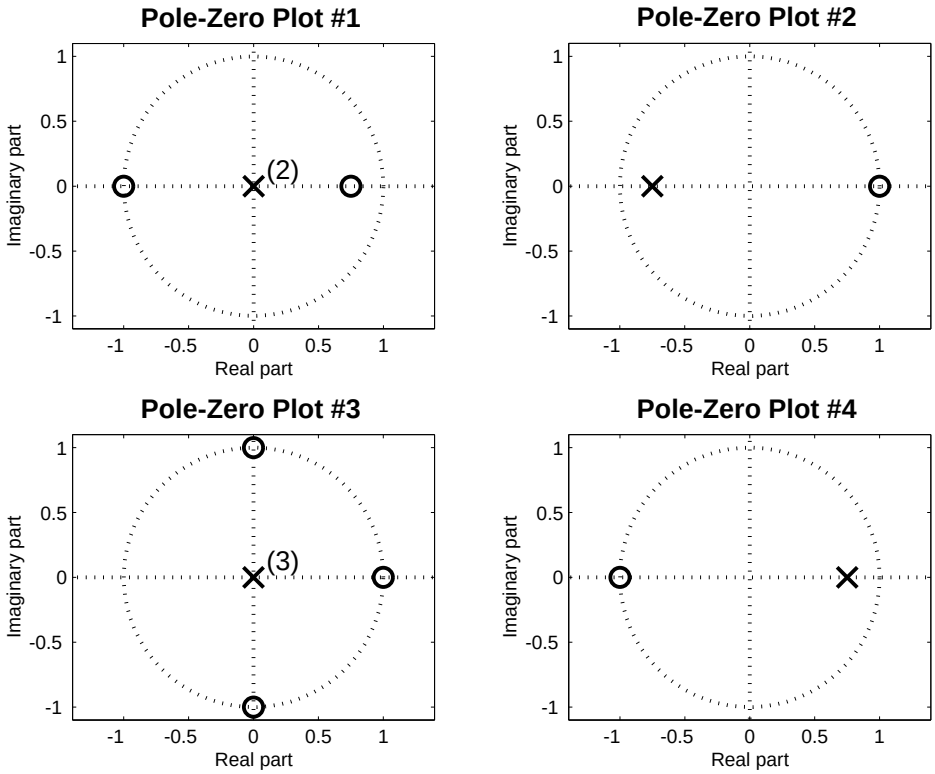
PROBLEM:



For each of the Pole-zero plots plots (1–4), determine the difference equation that defines the system.

1: **2:** **3:** **4:**

$\mathcal{S}_1$: $y[n] = 0.4y[n-1] + x[n] + x[n-1]$

$\mathcal{S}_2$: $y[n] = 0.75y[n-1] + x[n] + x[n-1]$

$\mathcal{S}_3$: $y[n] = -0.75y[n-1] + x[n] - x[n-1]$

$\mathcal{S}_4$: $y[n] = 0.75y[n-1] + x[n] - x[n-1]$

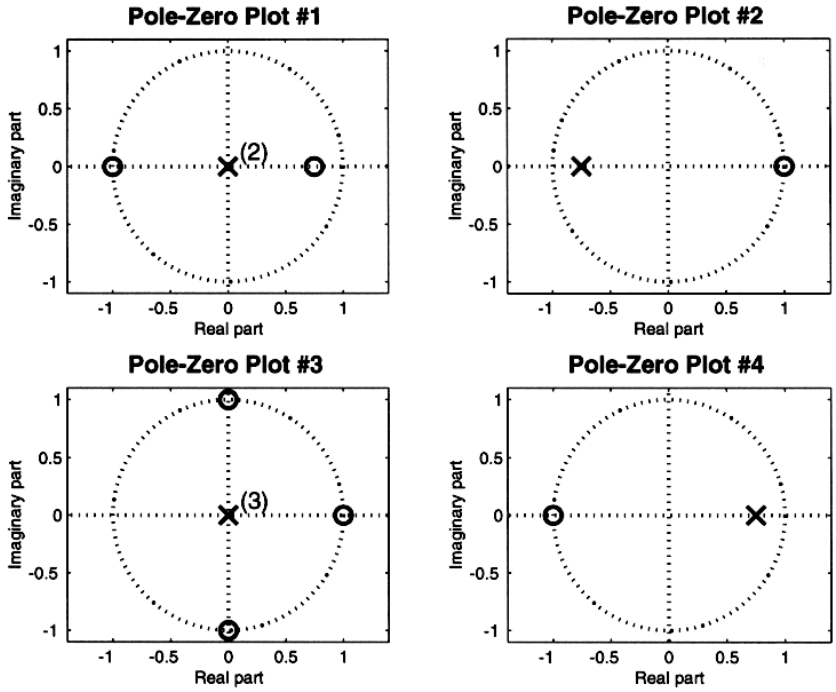
$\mathcal{S}_5$: $y[n] = x[n] - x[n-1] + x[n-2]$

$\mathcal{S}_6$: $y[n] = x[n] - x[n-1] + x[n-2] - x[n-3]$

$\mathcal{S}_7$: $y[n] = x[n] + \frac{1}{4}x[n-1] - \frac{3}{4}x[n-2]$

$\mathcal{S}_8$: $y[n] = \frac{1}{3}x[n] - x[n-1] + x[n-2] - \frac{1}{3}x[n-3]$

SOLUTION



For each of the Pole-zero plots plots (1–4), determine the difference equation that defines the system.[3] 1: S_7 2: S_3 3: S_6 4: S_2

$\mathcal{S}_1$: $y[n] = 0.4y[n-1] + x[n] + x[n-1]$

$\mathcal{S}_2$: $y[n] = 0.75y[n-1] + x[n] + x[n-1]$ $\quad \frac{1+z^{-1}}{1-0.75z^{-1}} = \frac{z+1}{z-0.75}$ zero: $z=-1$ pole: $z=3/4$

$\mathcal{S}_3$: $y[n] = -0.75y[n-1] + x[n] - x[n-1]$ $\quad \frac{1-z^{-1}}{1+0.75z^{-1}} = \frac{z-1}{z+3/4}$

$\mathcal{S}_4$: $y[n] = 0.75y[n-1] + x[n] - x[n-1]$ $\quad \frac{1-z^{-1}}{1-0.75z^{-1}}$

$\mathcal{S}_5$: $y[n] = x[n] - x[n-1] + x[n-2]$

$\mathcal{S}_6$: $y[n] = x[n] - x[n-1] + x[n-2] - x[n-3]$ $\quad 1 - z^{-1} + z^{-2} - z^{-3} = \frac{z^3 - z^2 + z - 1}{z^3}$ zero at $z=1$ at $z=j$

$\mathcal{S}_7$: $y[n] = x[n] + \frac{1}{4}x[n-1] - \frac{3}{4}x[n-2]$ $\quad 1 + \frac{1}{4}z^{-1} - \frac{3}{4}z^{-2} = \frac{z^2 + \frac{1}{4}z - 3/4}{z^2} = \frac{(z-3/4)(z+1)}{z^2}$

$\mathcal{S}_8$: $y[n] = \frac{1}{3}x[n] - x[n-1] + x[n-2] - \frac{1}{3}x[n-3]$

[3] These 8 systems are exactly the same as the other matching problems.