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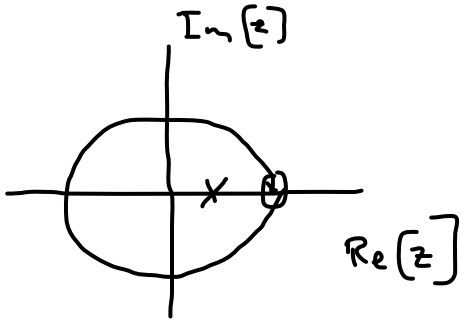
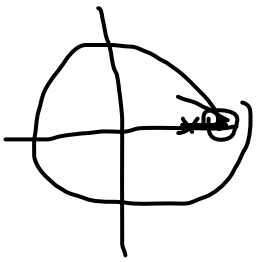
ECPE 121: Digital Signal Processing
Mini Exam 6 part a (12 pts total)

1. (6 pts) A digital filter has a zero at $z = 1.25$ and a pole at $z = 0.8$. Sketch the filter pole-zero plot. Use a graphical approach to determine the filter gain at the frequencies $\theta = 0$ and $\theta = \pi/2$ rad/sample. Draw and label relevant vectors on the sketch and show all relevant calculations.

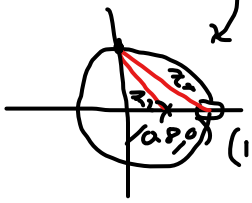


$\theta = 0$



$|H(e^{j0})| = 0$

$\frac{z_2}{z_1}$ = gain

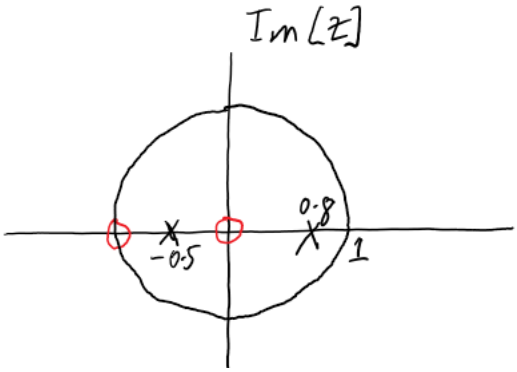


$\sqrt{0.8^2 + (-1)^2} = 1.28$

$\sqrt{(1.25)^2 + (-1)^2} = 1.6$

$\left|H\left(e^{j\frac{\pi}{2}}\right)\right| = \frac{1.6}{1.28} = 1.25$

2. (6 pts) The pole-zero plot of a causal filter is depicted below. Obtain the filter difference equation. Show all your work.



$$\frac{z(z+1)}{(z-0.8)(z+0.5)} = \frac{Y(z)}{X(z)}$$

$$\frac{z^2 + z}{z^2 - .3z - .4} \Rightarrow y(n) + y(n-1) = x(n) - .3x(n-1) - .4x(n-2)$$