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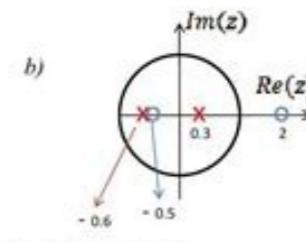
Example 2:

$$\text{Consider the discrete system, } H(z) = \frac{(z-2)(z+0.5)}{(z-0.3)(z+0.6)} = \frac{N(z)}{D(z)}$$

- a) Determine the poles & zeros.
- b) Plot (locate) them on the z-plane.
- c) Discuss the stability.
- d) Find the impulse response.
- e) Find the first 4 samples of $h(n)$.

✓ Solution:

a) zeros when $N(z)=0$
 $z_1=2$
 $z_2=-0.5$



c) Since all poles lies inside the unit circle, therefore the system is stable.

$$= \frac{1-z^{-1}}{(1-2z^{-1})(1-\frac{1}{2}z^{-1})}$$

$$= \frac{2/3}{1-2z^{-1}} + \frac{1/3}{1-\frac{1}{2}z^{-1}}$$

If the ROC is

(a) $|z| < \frac{1}{2}$:

$$h[n] = -\frac{2}{3}2^n u[-n-1] - \frac{1}{3}(\frac{1}{2})^n u[-n-1]$$

$$\Rightarrow h[0] = 0.$$

(b) $\frac{1}{2} < |z| < 2$:

$$h[n] = -\frac{2}{3}2^n u[-n-1] + \frac{1}{3}(\frac{1}{2})^n u[n]$$

$$\Rightarrow h[0] = \frac{1}{3}.$$

(c) $|z| > 2$:

$$h[n] = \frac{2}{3}2^n u[n] + \frac{1}{3}(\frac{1}{2})^n u[n]$$

$$\Rightarrow h[0] = 1.$$

(d) $|z| > 2$ or $|z| < \frac{1}{2}$:

$$h[n] = \frac{2}{3}2^n u[n] - \frac{1}{3}(\frac{1}{2})^n u[n-1]$$

$$\Rightarrow h[0] = \frac{2}{3}.$$

$$G(z) = \frac{z^n}{z - p_1}$$

Example 3.3 Find the Transfer Function.

Find the transfer function and the impulse response of a causal LTI system if the input to the system is

$$x[n] = \begin{pmatrix} -1 \\ 3 \end{pmatrix}^n u[n]$$

Solution:

 Step 1: Find the z-Transform of the input $X(z)$ and output $Y(z)$.

$$X(z) = \frac{1}{1 + \left(\frac{1}{3}\right)z^{-1}}$$

 With ROC $|z| > 1/3$

$$Y(z) = \frac{3}{(1+z^{-1})} \cdot \frac{1}{(1-\frac{1}{3}z^{-1})}$$

 With ROC $|z| > 1$.

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Z TRANSFORM AND DFT



Z Transform

Fourier Transform of discrete time signal:

$$X(e^{jw}) = \sum_{k=-\infty}^{\infty} x(k)e^{-jwk}$$

Given a sequence $x(n)$, its ***z transform*** is defined:

$$X(z) = \sum_{n=-\infty}^{\infty} x(n)z^{-n}$$

Where z is a complex variable $z = e^{j\omega}$

- The z transform does not converge for all sequences or for all values of z
 - The set of values of z for which the z transform converges is called region of convergence
 - The properties of the sequence $x(n)$ determines the region of convergence of $X(z)$

Slide 1

Impulse response transfer function z-transform

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