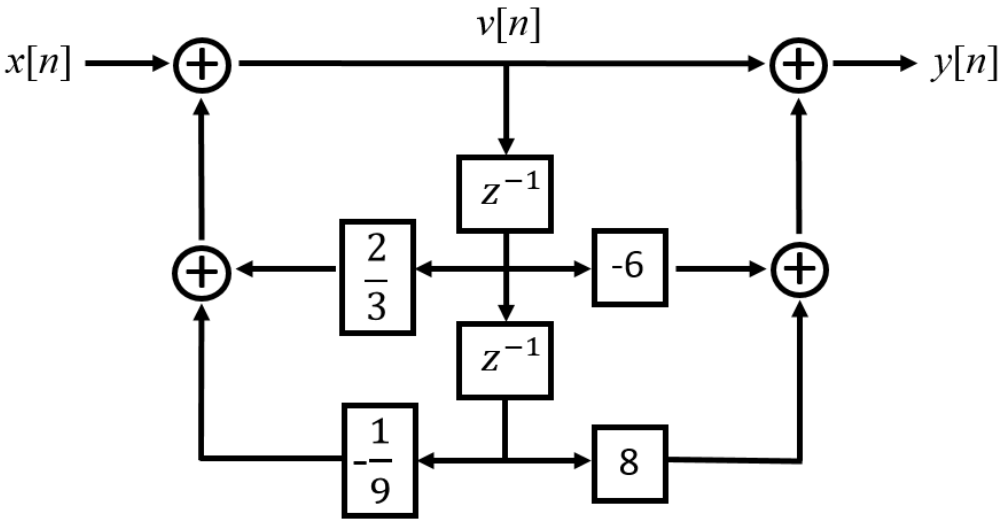
ICE503 DSP-Homework#6

1. Consider a causal LTI system whose input $x[n]$ and output $y[n]$ are related through the block diagram representation shown below:

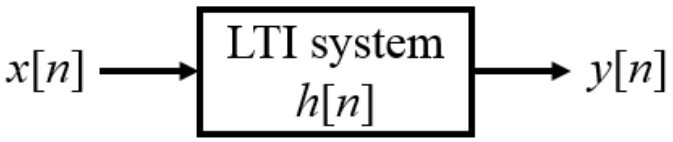


(a) Determine a difference equation relating $y[n]$ and $x[n]$.

(b) For pole(s) and zero(s) of the system function $H(z) = \frac{Y(z)}{X(z)}$, with $X(z)$ and $Y(z)$ being the z-transform of $x[n]$ and $y[n]$, respectively.

(c) Is this system stable? Why?

2. A causal linear time-invariant system $h[n]$ with input $x[n]$ and output $y[n]$ related according to the block diagram shown below:



When the input to the LTI system

$$x[n] = \left(\frac{1}{3}\right)^n \mu[n] + 2^n \mu[-n-1]$$

the corresponding output

$$y[n] = 5\left(\frac{1}{3}\right)^n \mu[n] - 5\left(\frac{2}{3}\right)^n \mu[n]$$

(a) Find the system function $H(z)$ of the system. Plot the pole(s) and zero(s) of

$H(z)$ and indicate the ROC.

(b) Find the impulse response $h[n]$ of the system.

(c) Write a difference equation that is satisfied by the given input and output.

(d) Is the system stable?

3. MATLAB simulation:

Given a causal system:

$$y[n] = 0.9y[n-1] + x[n]$$

(a) Find $H(z)$ and sketch its pole-zero plot.

(b) Plot $\left|H(e^{j\omega})\right|$ and $\angle H(e^{j\omega})$