ECE 351 DSP: Assignment 2

Instructor: Manuj Mukherjee

Total: 30 points

Submission deadline: 11:59PM 23.10.2023

A word on the notation: I shall represent finite duration causal signals as arrays. For example, $x[n] = [1, 2, 3]$ means $x[0] = 1$, $x[1] = 2$, and $x[2] = 3$, and $x[n] = 0$ for all other n.

All coding is to be done in Python. MATLAB codes will not be awarded any points.

1) Consider the system shown in Figure 1.
   a) What is its transfer function?
   b) What kind of a filter is it?
   c) What is its cutoff frequency?

[2+2+2=6 points]

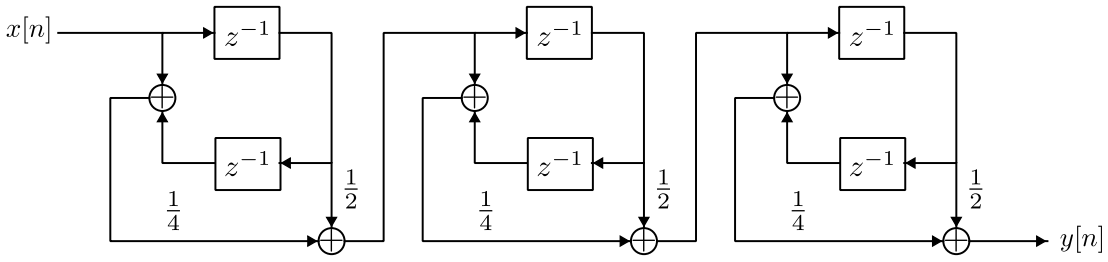

Fig. 1: Figure for Q.1

2) Consider the difference equation $y[n] = -\frac{1}{\sqrt{3}}y[n-1] + \frac{\sqrt{3}-1}{2\sqrt{3}}x[n] - \frac{\sqrt{3}-1}{2\sqrt{3}}x[n-1]$.
   a) Find $H(z)$.
   b) Identify the filter type.
   c) Compute its cutoff frequency.
   d) Write a python code to plot its group-delay for $\omega \in [0, \pi]$.

[2+2+2+3=9 points]

3) Write a python code to obtain $h[n]$ for an FIR system given the lattice reflection coefficients K_is. The code needs to ask for an input M, and $K_1, K_2, \ldots, K_{M-1}$. The code should output $h[n]$ as an array and plot its zeros using a pole-zero plot.

[15 points]