Problem 12 **(round-off effects in digital filters)**

The flow graph of a first-order system is shown in figure 1

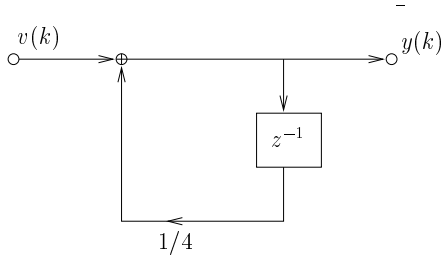

Figure 1: First order system

(a) Assuming infinite-precision arithmetic, find the response of the system to the input

$$v(n) = \begin{cases} .5 & \text{for } n \geq 0 \\ 0 & \text{for } n < 0 \end{cases}$$

What is the result for large n?

Now suppose that the system is implemented with fixed-point binary arithmetic. The coefficients and all variables in the network are represented in sign-magnitude notation with 5 bit $(b_0 b_1 b_2 b_3 b_4)$, b_0 denoting the sign. The result of a multiplication of a sequence value by a coefficient is truncated before additions occur.

(b) Compute the response of the quantized system to input of part a), and plot the responses of both the quantized and unquantized systems for $0 \leq n \leq 5$. How do the responses compare for large n?

(c) Now consider the system depicted in figure 2, where

$$v(k) = \begin{cases} .5(-1)^n & \text{for } n \geq 0 \\ 0 & \text{for } n < 0 \end{cases}$$

Repeat part a), and b) for this system and input.

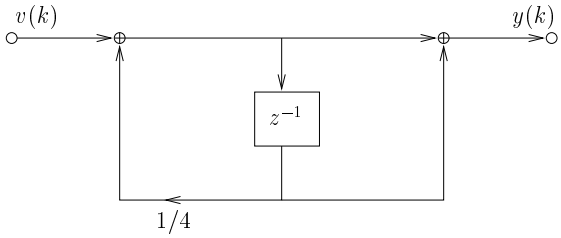

Figure 2: System for part c)