**PROBLEM:**

The diagram in Fig. 1 depicts a *cascade connection* of two linear time-invariant systems; i.e., the output of the first system is the input to the second system, and the overall output is the output of the second system.

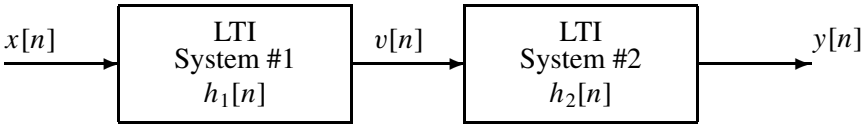


Figure 1: Cascade connection of two LTI systems.

Suppose that System #1 has impulse response,

$$h_1[n] = \begin{cases} 0 & n < 0 \\ 0.1 & n = 0 \leq n \leq 9 \\ 0 & n > 9 \end{cases}$$

and System #2 is described by the difference equation

$$y[n] = v[n] - v[n-1]$$

(a) Determine the difference equation of System #1; i.e., the equation that relates $v[n]$ to $x[n]$.

(b) When the input signal $x[n]$ is an impulse, $\delta[n]$, determine the signal $v[n]$ and make a plot.

(c) Determine $h_2[n]$, the impulse response of System #2.

(d) Determine the impulse response of the overall cascade system, i.e., find $y[n]$ when $x[n] = \delta[n]$.

(e) From the impulse response of the overall cascade system as obtained in part (d), obtain a single difference equation that relates $y[n]$ directly to $x[n]$ in Fig. 1.