1. Consider the system $y[n] = x[n+1] – 2x[n] + x[n-1]$

   a. Is it linear?

   b. Is it shift-invariant? (shift-invariance is the discrete time equivalent of time invariance).

2. Consider a moving average filter of length 3 and the input signal $x[n] = \delta[n] + 3\delta[n-1] - 4\delta[n-2]$.

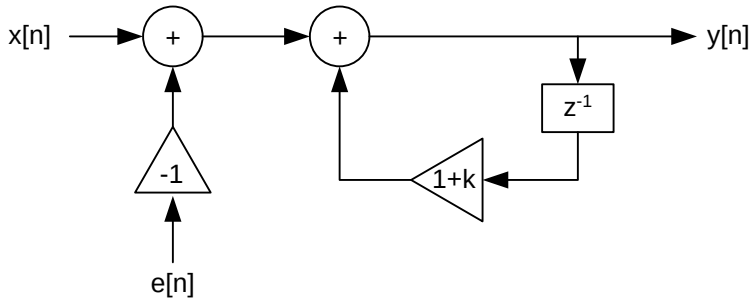
   a. Find y[0], y[1], y[2], y[3], y[4] (i.e. evaluate to 5 numbers)

   b. Find the total energy in x[n]

   c. Find the total energy in y[n]

   d. Does this example suggest the system is lossless? Passive? (Note: To prove the system is lossless or passive you must prove it is so for all possible inputs – I am asking only for this specific input).

3. A model of your savings account y[n] at month n may look as follows



   where x[n] is your monthly income
   e[n] are your monthly expenses
   k[n] is your monthly interest rate on your savings account (e.g. 0.01 for 1%)

   a. If e[n] is 2500 u[n] then is the system linear? Causal? Shift-invariant? (Careful: for linearity, a zero signal in must give a zero signal out, e.g. scaling with a zero).

   b. If x[n] is 4000 u[n], e[n] = 2500 u[n], and k is 0.01 (i.e. 12% annual interest), calculate how much your savings account will hold after 10 years (i.e. y[120]). You may find writing a quick program in Matlab much faster than calculating it by hand, or you may be able to derive an explicit mathematical relationship.

   c. Use Matlab to graph the **impulse response** (h[n], not y[n]) for the first year given the above values, with e[n] = 0.