Exercises Week4

DSP

1. Compute the convolution of the two sequences $x_1 = ...0, 0, 1, 2, \underset{\uparrow}{1}, 3, 1, 4, 0, 0, ...$ and $x_2 = ...0, 0, 3, \underset{\uparrow}{2}, 1, 0, 0, ...$, in two ways:

   a. in the time domain
   b. using the sliding window transform
   c. using polynomials (e.g. using the Z transform)

2. Compute the 2D convolution of the image

$$I = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 2 & 2 & 2 & 2 & 2 \\ 3 & 3 & 3 & 3 & 3 \end{bmatrix}$$

   with the kernel image:

$$H = \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

   Note: the result must be the same shape as the input signal.

3. Find the Z transform of the following signals

   a.

$$x[n] = \begin{cases} \left(\frac{1}{3}\right)^n, & n \geq 0 \\ \left(\frac{1}{2}\right)^{-n}, & n < 0 \end{cases}$$

   b.

$$x[n] = \left(\frac{1}{2}\right)^n \sin(\frac{\pi}{3}n)u[n]$$