Exercises Week 4

DSP

1. 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.

2. Compute the convolution of the signals $x_1[n] = \{..., 0, 1, 2, 3, 4, 0, ...\}$ and $x_2[n] = \{..., 0, 2, 2, 3, 3, 0, ...\}$ using the Z transform.

3. Find the Z transform of the following signals:

   a.
$$x[n] = \left(\frac{1}{3}\right)^n u[n]$$

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

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