Exercises Week 3

DSP

1. Consider the following discrete signal $x[n]$:

$$x[n] = \begin{cases} 1 + \frac{n}{3}, & -3 \leq n \leq -1 \\ 1, & 0 \leq n \leq 3 \\ 0, & elsewhere \end{cases}$$

   a. Write the expression of $x[n]$ based on the signal $\delta[n]$
   b. Write the expression of $x[n]$ based on the signal $u[n]$

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

3. 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.