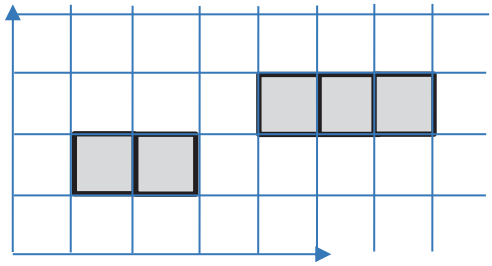
CS/RBE 549 Computer Vision
Fall 2022

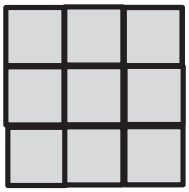
Name:_____

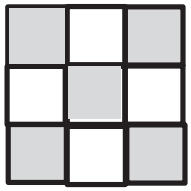
HW #2

1. The following binary image B =



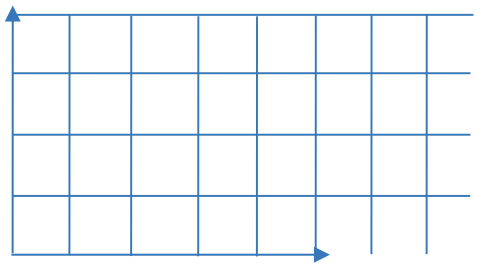
is operated on by structuring elements (gray means 1, white means 0)

S1= 

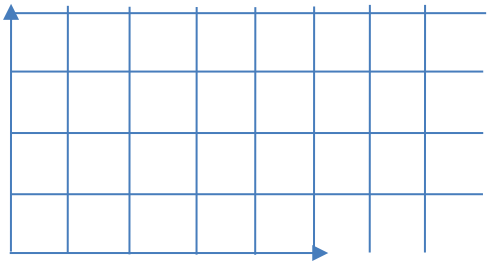
S2= 

Assume that any pixels outside the region shown are 0. This is equivalent to assuming that B is embedded in a (potentially infinitely) larger image that is all 0.

a. What is obtained by dilating B by S1 and then eroding that result by S2?
Please provide step by step results for partial credits.



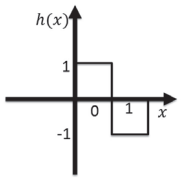
b. What is obtained by dilating B by S2 and then eroding that result by S1?Please provide step by step results for partial credits.



2. Show that convolution is associative, that is

$$f(\vec{x}) * \big(g(\vec{x}) * h(\vec{x})\big) = \big(f(\vec{x}) * g(\vec{x})\big) * h(\vec{x})$$

3. What is the Discrete Fourier Transform of the simple x-direction mask, assuming that the 1 value is at the origin?



Use the 1-D DFT formula $H(k) = \sum_{x=0}^{N-1} h(x)e^{-j\frac{2\pi kx}{N}}$ as Equation 3.57 in Szeliski Computer Vision 2nd Ed. You should be able to express the result as [constants] × $e^{[\text{something}]}$ × sin[something]. note: Equation 3.57 should not contain 1/N.

4. Use OpenCV in your favorite language (Python, C++, MATLAB, etc) to smooth an image using the following operations:
   a. Box Filter with $W = 3$ in both directions,
   b. Gaussian with σ=5, and
   c. Median Filter using a 5×5 window (see Szeliski Figure 3.19)

   Show the original image – your choice! – and the 3 smoothed images.

   Answer the following: What happens if you change the window size?