IP Assignment 3

Visual Computing Fundamentals

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Task 1

a)

Dilation is essentially equivalent to max-pooling, where the output pixel is decided by the maximum value of the neighbouring pixels in the input. The effect of this is that objects have a clearer outline, such that they are more visible.
Erosion is the opposite, a min-pool, where the output pixel is decided by the minimum value of the neighbouring pixels. This removes (in the case of binary images) isolated pixels and only leaves the "important" and large objects in the scene.
Opening in this context refers to first applying erosion to remove small and bright "non-important details" or noise, and then applying dilation to emphasize what's left.
Closing on the other hand applies the operations in the opposite order, first dilation and then erosion. This can help with removing small and dark details, e.g. filling in small gaps in an object.

b)

Smoothing is done to remove noise from the image, such that we can more accurately identify the edges.

c)

Hysteresis thresholding is a thresholding technique utilized for determining which edges we ought to include. It works by setting a lower and a higher threshold, and discarding anything below the lower threshold, and keeping anything above the higher threshold. We then check whether the edge points we found between the two thresholds are connected to the ones we found above the high threshold, and if they are, we also keep them.

d)

The issue with a single threshold is that if the value is too low we end up with a large amount of noise, and if the value is too great we might end up with a disconnected outline of the object we are looking for. Hysteresis thresholding allows us to account for the different edges of an object having different intensities, by using the first threshold to figure out which edges are certain to be relevant, and allowing some flexibility in the area between the two thresholds, depending on whether the edges there are connected to the definitive edges.

e)

Apply the structuring element as you would any other kernel. There are a bit too many steps here to write out each one, so I'll illustrate the first row and just fill in the rest.
I'm going to consider the top left to be origo, with column-major indexing.

$0, 0 = max(0, 1 * 1) = 1$

$0, 1 = max(0 * 1, 1, 0 * 1) = 1$

$0, 2 = max(1 * 1, 0, 1 * 1) = 1$

$0, 3 = max(0 * 1, 1, 0 * 1) = 1$

$0, 4 = max(1 * 1, 0, 0 * 1) = 1$

$0, 5 = max(0 * 1, 0) = 0$

End result:

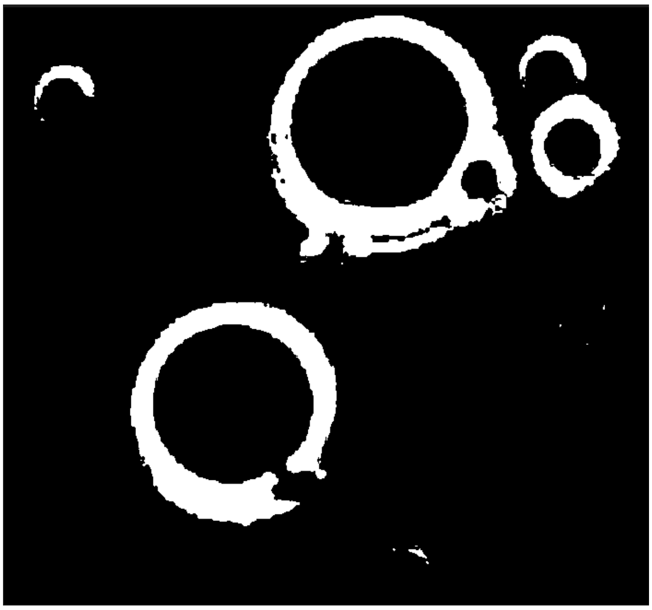
1	1	1	1	1	0
1	1	1	1	1	1
1	1	1	1	1	0
0	0	0	0	0	0
0	1	1	1	0	0
0	0	0	0	1	1

Task 2

a)

Thumbprint (found optimal threshold of 154):

Polymer cell (found optimal threshold of 182):



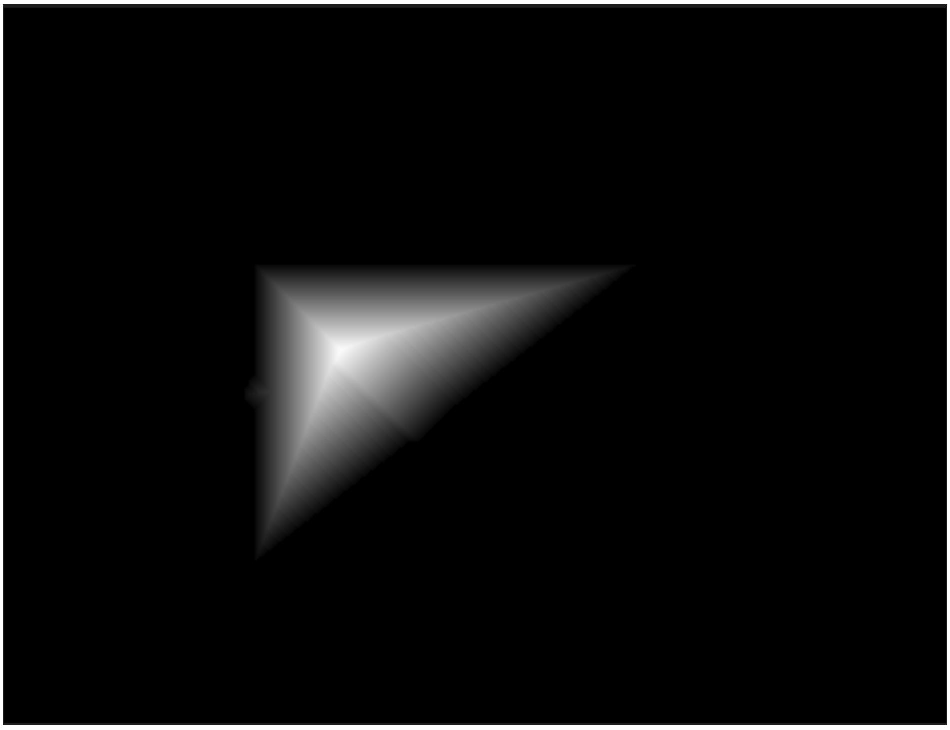
b)

Task 3

a)

I removed the noise in the image by first applying 3 steps of binary dilation with a Von Neumann neighbourhood with a radius of 2 (skimage.morphology.disk(2)) to fill in the gaps in the middle of the triangle. I then proceeded to apply 7 steps of binary erosion to get rid of the noise outside of the triangle. The amount of steps needed discovered by simply dilating until the triangle was filled, and then eroding until the triangle was the only thing left.

b)



c)

d)