

## Assignment 6 (50)

### Mathematical Morphology.

A MatLab reference: <https://www.mathworks.com/help/images/morphological-filtering.html>

A Python tutorial: [https://opencv-python-tutroals.readthedocs.io/en/latest/py\\_tutorials/py\\_imgproc/py\\_morphological\\_ops/py\\_morphological\\_ops.html](https://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_imgproc/py_morphological_ops/py_morphological_ops.html)

#### Problem 1: Erosion and Dilation (20)

Choose a gray scale image (or convert a color image to grayscale). Convert to binary based on a mean-intensity threshold. Apply erosion twice and then dilation twice with a structuring element of your choice. (Defaults are fine.) Then, starting with the original binary image, dilate twice and erode twice. Show the two resulting images and contrast them.

#### Problem 2: Opening and Closing (20)

Using the binary image from Problem 1, apply opening twice and then closing twice with a structuring element of your choice. (Defaults are fine.) Then, starting with the original binary image, close twice and open twice. Show the two resulting images and contrast them. Then, compare how your two images from Problem 2 visually differ from the two images of Problem 1.

#### Problem 3: Boundary Extraction (10)

Boundary extraction of an image  $I$ ,  $\beta(I)$ , can be performed by eroding  $I$  with a structuring element  $B$  and then subtracting the eroded image from  $I$ :

$$\beta(I) = I - (I \ominus B)$$

Using your binary image from the two problems above, extract the boundaries. Then, extract Canny edges from the original grayscale image. Show the two images and compare them.

#### General submission instructions:

- Be kind to your aging, over-worked professor and submit only a single document. This can be pdf, MS Word, OpenOffice, etc. Do not submit a zip file.
- Your single document should include the input image for your problem, if required, and answers to each of the sub-problems (text, image or both, as appropriate). Your document should also include code that you wrote to generate your answers.
- You may use any images you like for the programming; I encourage you to use images that might be useful/interesting for your final project.
- Feel free to use whatever functions MatLab supplies, except where otherwise specified. Also feel free to write your own, if you are so inclined; it will take more time, but you

will gain a deeper understanding of the material. It is one thing, for example, to implement Otsu thresholding using `otsuthresh`, quite another to write an thresholding technique yourself.

- (e) Point values for each question are indicated as  $x/y$  in which  $x$  is the point value for 481 students and  $y$  is the point value for 381 students.