COMP2005 Laboratory Sheet 5: Morphology

1. Structuring Element

Morphological operations require an input binary image and a structuring element. Structuring elements vary in shape and size, similar to filter masks used in spatial filtering. You can create structuring elements using *getStructuringElement*:

- Create an elliptic structuring element of sizes 3, 5 and 7.
- Do the same for a rectangular and cross-shaped structuring element. (Note: You can also create a rectangular structuring element using NumPy's *ones* function)

2. Dilation

Dilation is a morphological operation which expands the foreground using a structuring element. This is done by expanding the boundary of the foreground, which in turn closes the gaps between regions. The amount and direction of expansion are based on the chosen structuring element.

- Read in the *Square-Hole.jpg* image from Moodle.
- Perform dilation with *dilate* using the 9 structuring elements you have created. Compare the differences when using different shapes and sizes of structuring elements. Notice the effect on both the hole and the borders (particularly corners).
- Using the *text_broken.tif* image, perform dilation to fill in the gaps between the broken characters.

3. Erosion

Erosion is the opposite of dilation, where the boundary of the foreground is shrunk instead, or it can also be thought of as performing dilation on the background. It is used to separate touching objects or remove small noise components.

- Read in the *Squares.tif* image from Moodle.
- Perform erosion with *erode* using all the structuring elements and compare the differences. Take note of the effect on both the small and large squares.

4. Opening

Opening is a morphological operation which involves performing erosion on an image and then performing dilation. It helps smooth the contours of the foreground and removes small unwanted components.

- Read in the *Cells.png* image from Moodle. (Note: The image is a colour image, you will need to convert it to binary first. Ensure that the cells are the foreground.)

- Perform opening on the image with *morphologyEx*. Use a suitable structuring element to remove the small cells so that the image only contains the large cells.

5. Closing

Closing is the opposite of opening, whereby dilation is performed first before erosion. It is used to fill small gaps between regions and smooth the boundaries.

- Read in the *dark_blobs.tif* image from Moodle.
- Construct a suitable structuring element to perform closing on the image. Try to remove the small holes while still maintaining the original sizes of the large holes.

6. Some Applications

Boundary Extraction

Both dilation and erosion change the size and boundary of the foreground object (in opposite ways; i.e., they expand or shrink, respectively). This change can be utilised to extract the approximate object boundaries.

- Read in the *lincoln.tif* image from Moodle.
- Perform dilation on the original image and subtract the original image from the dilated image.
- Perform erosion on the original image and subtract the eroded image from the original image.
- Compare the two outputs. Which method produced the best result and why?

Noise Reduction

You are provided with a fingerprint image, but it is contaminated with noise. Your **mission impossible** task is to reduce the noise and provide a clean enhanced image of the fingerprint so that the forensic team can reliably use it in their investigation (*as how you normally see on the CSI TV show*). Make sure you understand and can explain your results.

7. Expected Results

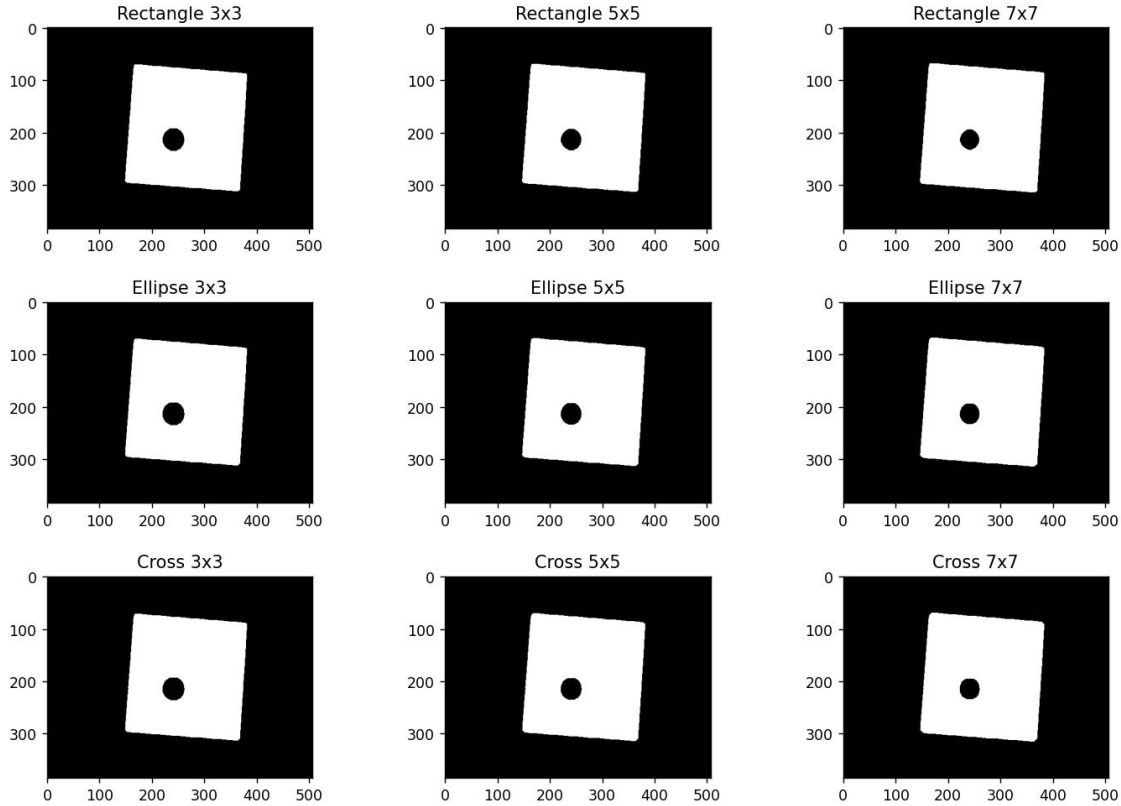

Figure 1: Dilation on *Square-Holes.jpg*

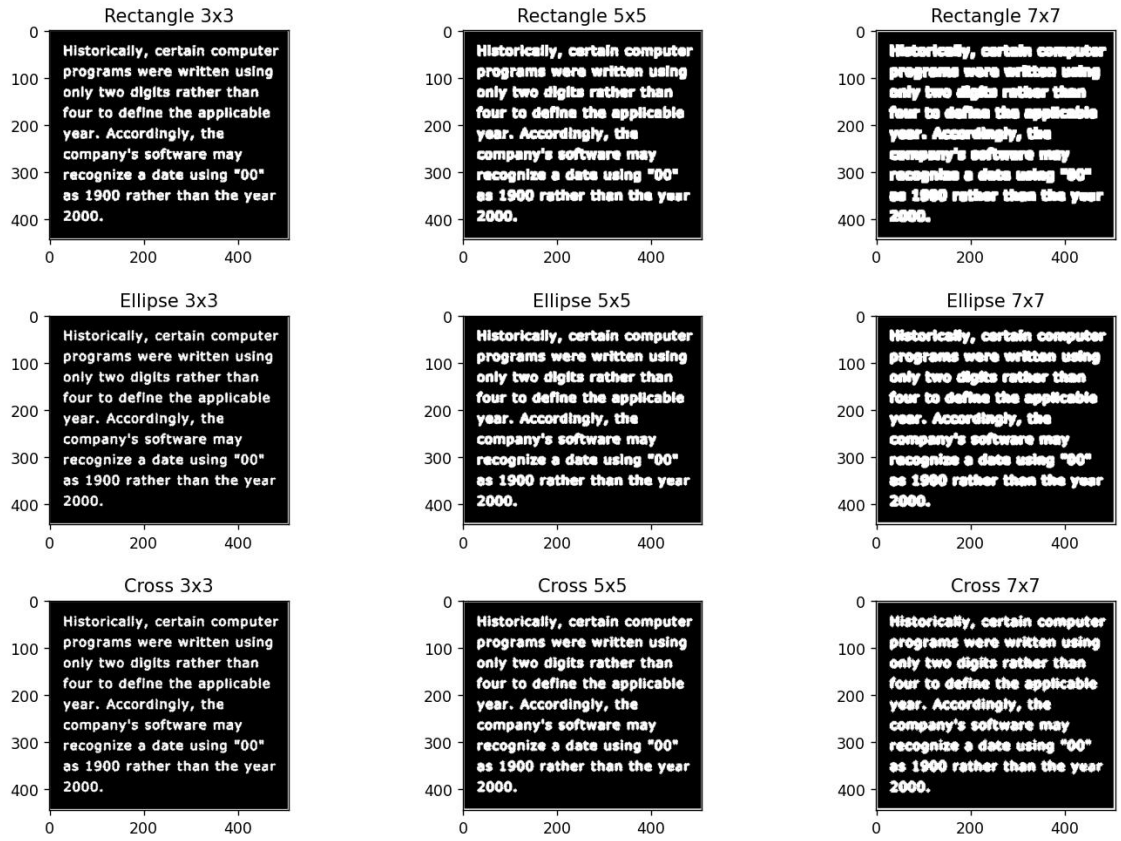

Figure 2: Dilation on *text_broken.tif*

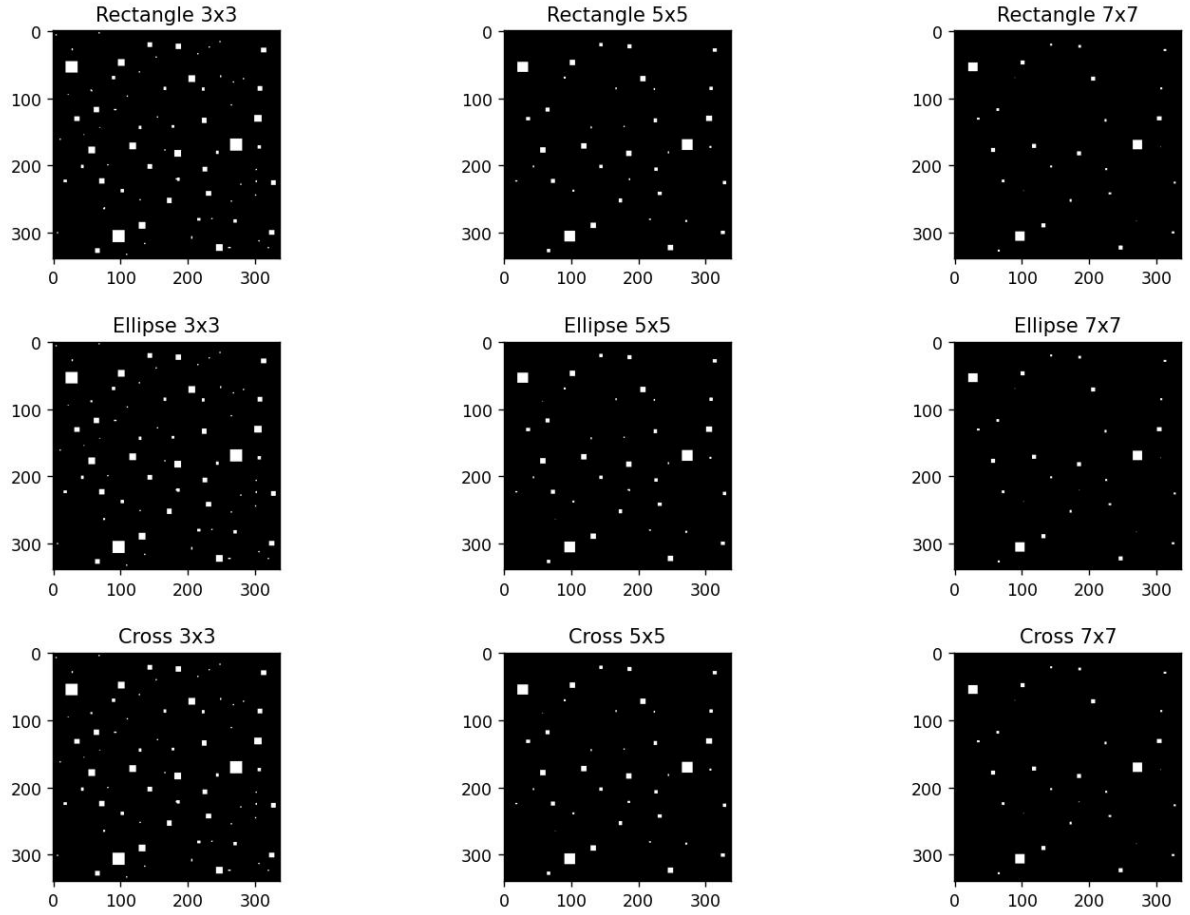

Figure 3: Erosion

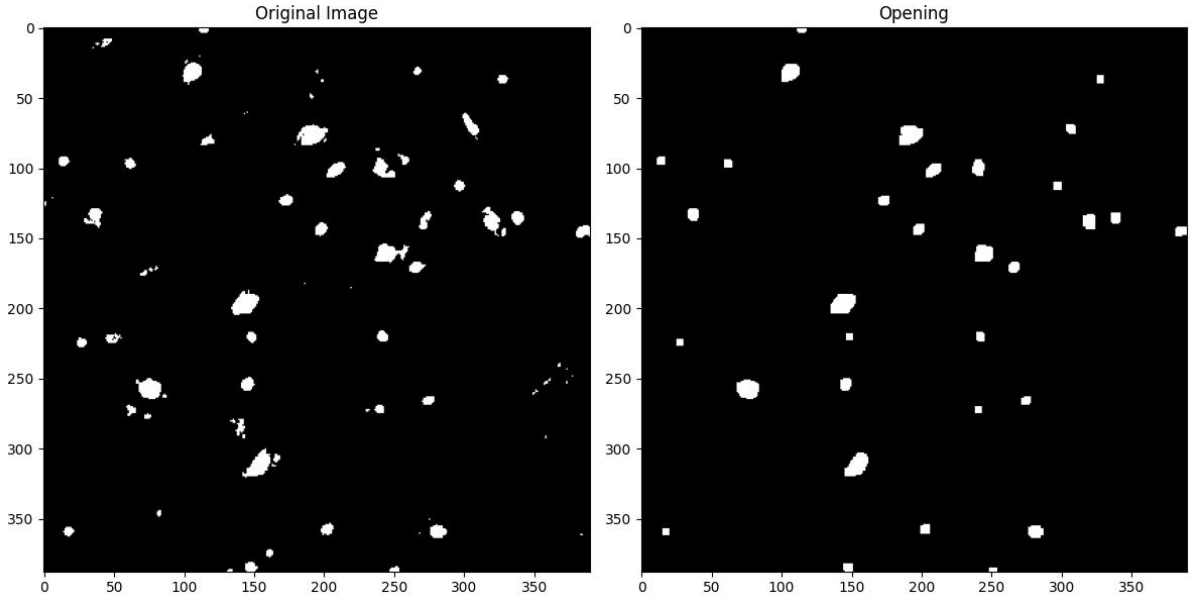

Figure 4: Opening

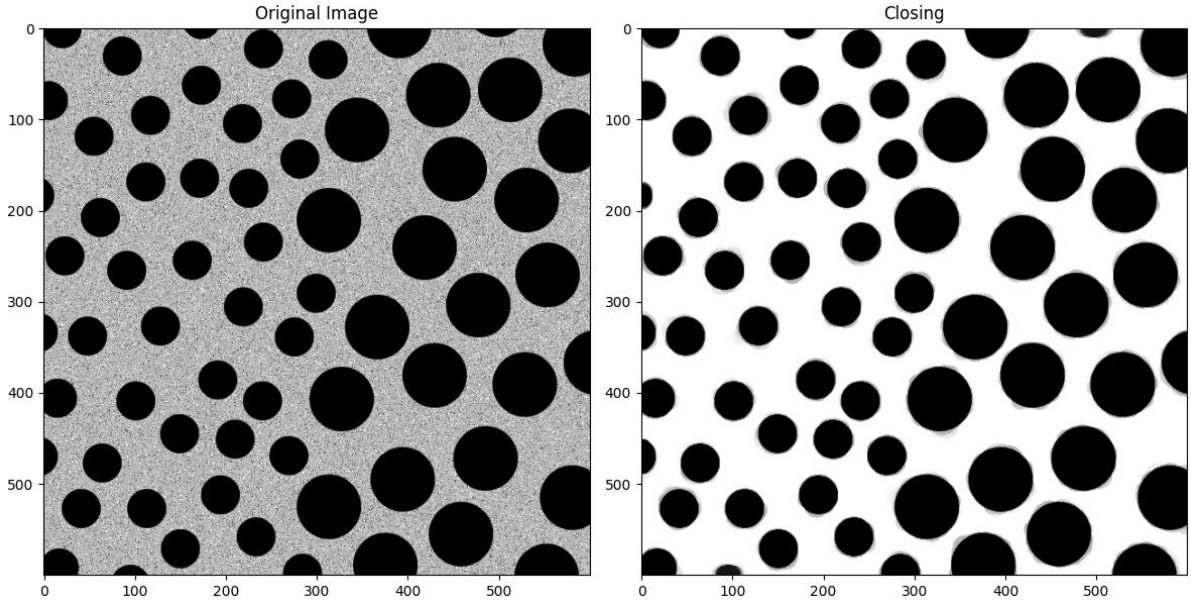

Figure 5: Closing

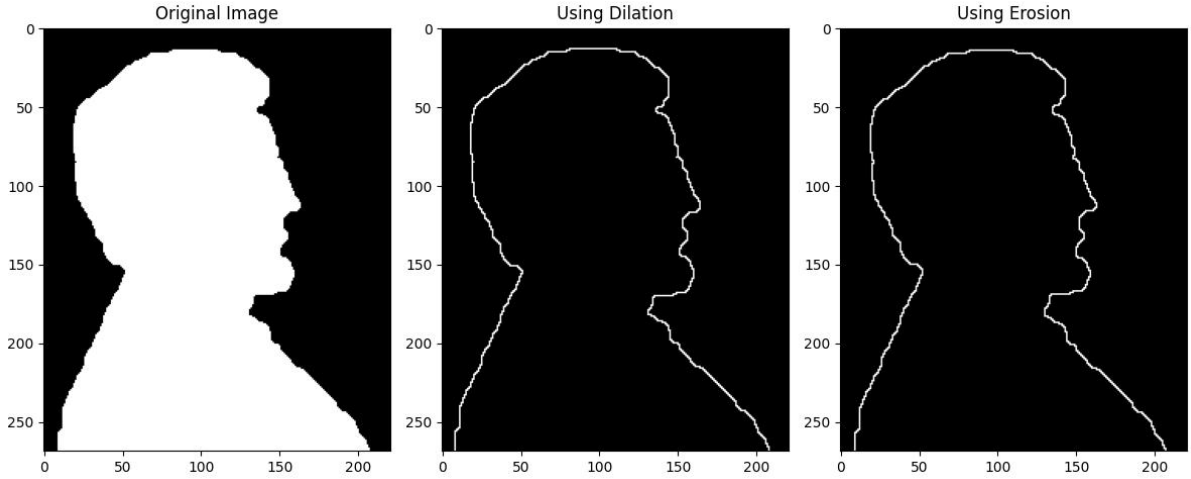

Figure 6: Boundary Extraction