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Homework 5

Write programs which do gray-scale morphology on a gray-scale image(lena.bmp):
(a) Dilation
(b) Erosion
(c) Opening
(d) Closing

The requirements above are accomplished by Python. All the histograms are created by matplotlib package, and all the processed images are exported by cv2 package.

(a) Dilation

For the dilation function, I use a binary octagon as the kernel implemented by 5×5 np.array. The inputs of the function are original three dimensional image and the kernel array.

According to the definition of kernel dilation function, each pixel in the new image is filled with the local maximum value of its neighbor pixels including itself. The kernel is applied on each pixel of lina.bmp image to detect the neighbor pixels by judging if the corresponding cell in kernel is 1. For each pixel of original image, the boundary of neighbor pixels needed to be detected is calculated before finding the local maximum. The two dimension (length and width) array for new image is created after all the operations. Then, I use np.stack to stack three same two dimensional dilation binary array into the three dimensional image array. At last, the function will return the image processed by dilation of grey level image.

(b) Erosion

For the erosion function, I also use a binary octagon as the kernel implemented by 5×5 np.array. The inputs of the function are original three dimensional image and the kernel array.

According to the definition of kernel erosion function, each pixel in the new image is filled with the local minimum value of its neighbor pixels including itself.

The kernel is applied on each pixel of lina.bmp image to detect the neighbor pixels by judging if the corresponding cell in kernel is 1. Different from the dilation, all the pixels needed to be detected for operation is pre-calculated before the double for-loops because there is no need for the boundary pixels of the image where kernel cannot fit. Those boundary pixels of the returned image need to be performed erosion, so I just set them as 0 in the first place. Then, I use np.stack to stack three same two dimensional array into the three dimensional image array. At last, the function will return the image processed by erosion.

(c) Opening

According to the definition of opening, I apply the erosion function on original image first, and then apply the dilation function to the eroded image to get the opening image.

(d) Closing

According to the definition of closing, I apply the dilation function on original image first, and then apply the erosion function to the dilated image to get the opening image.

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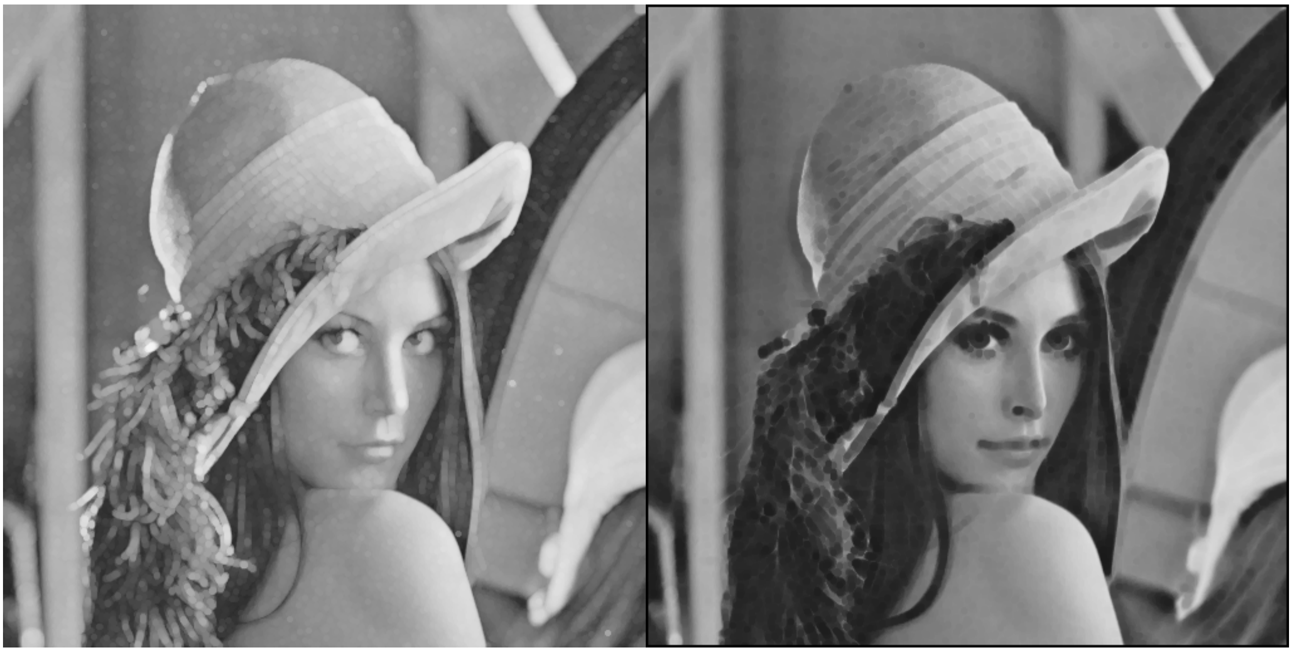

Figure 1. The left one is the image with grey level dilation. The right one is the image with grey level erosion.

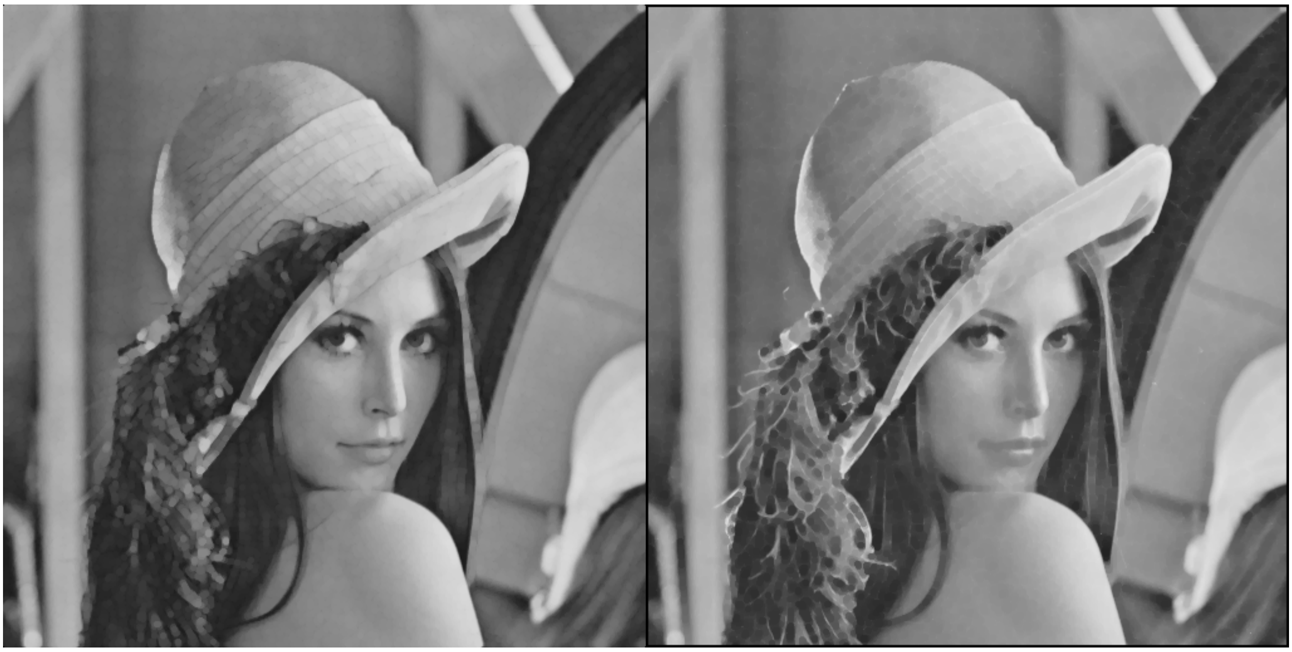

Figure 2. The left one is the image with grey level opening. The right one is the image with grey level closing.