Assignment 4

Due Date:2022/02/20

Assessment: 4% of total course mark

Instructions:

- For coding problems, please include the results as well as the screenshots of codes in the report
- Please upload source codes along with the report in Avenue (1 zip/rar file including codes, results and 1 PDF report file)
- The report MUST be written in Latex
- The codes MUST be written in Python language
- Please write comments for your codes!
- The explaination about the code MUST be included in the report!

Theory (70 %)

1 Morphology Operations, 30 %

Consider the following binary image.

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

1.1

Apply erosion on the image using the following structuring element.

$$SE = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 0 \end{pmatrix} \tag{1}$$

1.2

Apply dilation on the image using the following structuring element.

$$SE = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \tag{2}$$

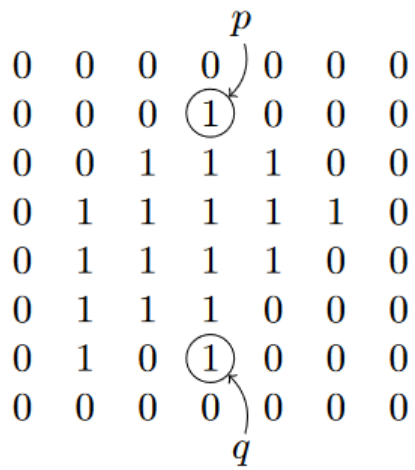
1.3

Apply opening on the image using the following structuring element.

$$SE = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix} \tag{3}$$

2 Distance and boundary, 30 %

Let R be a subset of pixels in an image. We call R a region of the image if R is a connected set. The boundary of a region R is the set of pixels in the region that have one or more neighbours that are not in R. In the following image, all pixels with value "1" constitute a region.



2.1

Mark the boundary pixels of the region in the sense of 4-neighbours and 8-neighbours respectively in the images below.

4-neighbours

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

8-neighbours

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

2.2

A boundary image is a binary image where “1” represents a boundary pixel and “0” represents a non-boundary pixel in the original image. In the boundary image in the sense of 4-neighbours, what are the D_8 and D_m distances between points p and q?

2.3

In the boundary image in the sense of 8-neighbours, what are the D_4 and D_m distances between points p and q?

3 Extracting License Plate, 10 %

Consider the following image:

Outline an algorithm to extract the license plate. (in your algorithm you can use filtering, edge detection, contour finding, morphological operations)

Implementation (30 %)

1 Extracting License Plate (30 %)

Implement your solution you have proposed in question 3. Save the result. Your algorithm should be robust to slight changes in angle, scale and illumination condition of the image. Explain how your algorithm is robust to these?
