

Homework 4: Morphological Image Processing

Due date: 2pm May 31, 2016

Submission files:

- 1) Source code: the code should work well with no modification. Provide 'readme.txt' and an interface for easily setting input images and parameters used in the code.
- 2) Technical report including all results and analysis

Programming tools: C (C++) or MATLAB depending on your preference

1. Hit-or-Miss Method

We will perform a simple license plate recognition using Morphological image processing. Use the MATLAB functions: `imerode`, `imdilate`, `graythresh`

Test image: clean and noisy plate images ('license_clean.png', 'license_noisy.png')

Template image: character template images ('character_template.zip')

1-1. Binarize the two test images using Otsu's segmentation method in MATLAB (`graythresh`). Choose the threshold by applying Otsu's method to the clean images, and then use the same threshold for remaining images.

1-2. Perform the character recognition using a simple erosion operation as follows:

- a) Apply the erosion to the binarized template images (SE: 3x3 square) in order to mitigate the effect of slightly mismatched regions.
- b) Apply the erosion to the binarized clean and noisy plate images (SE: the eroded template image from a)).
- c) Apply the dilation to detected result (SE: eroded template image from a)), and then overlay it on the binarized image as follows.



1-3. Perform the character recognition using a hit-or-miss method. The procedure is the same as the above except using the hit-or-miss method in b). Also, analyze how the noise affects the hit-or-miss algorithm.

- a) Apply the erosion to the binarized template images (SE: 3x3 square) in order to mitigate the effect of slightly mismatched regions.
- b) SE1: the eroded template image from a)
SE2: the dilated template image using 5x5 square – the dilated template image using 3x3 square.
- c) Apply the dilation to detected result (SE: eroded template image from a)), and then overlay it on the binarized image as in 1-2.

1-4. Perform the character recognition using a rank filter in MATLAB (use '`ordfilt2`').

`min(ordfilt2(image, p1, SE1), ordfilt2(~image, p2, SE2))`). Note that setting $p1=p2=1$ is identical to the hit-or-miss method. Choose appropriate $p1$ and $p2$ that produce correct detection results in the noisy plate image.

2. Dilation and Erosion

2-1. Enhance a blurry image (named 'blurry.jpg') by sequentially applying the dilation and erosion. A structure element (SE) can be designed in a way of producing the best performance. The procedure can be summarized as follows:

$Im(0)$ = input image

Apply the following steps at iteration k ($k=1\sim N$)

a) Apply the dilation to $Im(k-1)$: Im_d

b) Apply the erosion to $Im(k-1)$: Im_e

c) Compute a mean result of a) and b): $Im_h = (Im_d + Im_e)/2$

d) Perform the following test for each pixel:

$Im(k-1) \geq Im_h$? $Im(k) = Im_d$: $Im(k) = Im_e$

2-2. Plot an intensity profile in row 330 of intermediate results during iterations. Comment on how the intensity profile varies, and then explain how this algorithm works.

* Note

In technical report, you should include the following three things.

- 1) Description of your algorithm
- 2) The reason of the parameter setting you chose in your source code.
- 3) Show the results of your algorithm using various images which you want to use.