

CENG 466

Fundamentals of Image Processing

Fall '2020-2021

THE 3

Due date: January 15, 2021, Friday, 23:55

1 Objectives

The purpose of this assignment is to familiarize you with the fundamental morphological image processing techniques and image segmentation. You are expected to carry out these tasks using algorithms you have covered during the lectures.

2 Specifications

You are given three questions, which you should solve with your own algorithms. In addition to the solutions, you are required to prepare a report that explains your methodology and includes the analysis of the results and your comments on them. The report should be **3-8 pages** long and should be prepared in IEEE Conference Proceedings Template (**L^AT_EX** is recommended) provided in the following link.

https://www.ieee.org/conferences_events/conferences/publishing/templates.html

- Grading will be based on the quality of the outputs, script contents and the report
- The report should clearly explain the methodology and rationale behind the algorithm design. It should also explain the difficulties encountered in the design, implementation and experimentation stages, and your solutions on them. Last but not least, the report should contain your comments on the results. Even if the results do not match your expectations you should discuss the encountered situation.

Question 1 (40 Points) - Object Counting

In this part, your task is to count the number of flying jets in the images given in Figure 1. You should write your code in a script named as *the3_part1*. Your algorithm should output an image (*part1_AX.png*) which shows the counted objects. For this purpose, you can provide a black and white image where the white pixel groups corresponds to the detected objects. Also, your script should output;

The number of flying jets in image AX is n

where n is computed by the script. The solutions should be done using only mathematical morphology. Explain your work in detail.



Figure 1: Images of Part 1

Question 2 (40 Points) - Segmentation

In this part, your task is to develop an image segmentation algorithm that can separate dogs from their background. While developing your algorithm you can exploit any information about the image like color, contrast and brightness. You may also use the spatial information in order to preserve edges and boundaries of the regions. In this part, you are free to use any of the methods that you have learned so far for preprocessing and post processing.

You should write a function named as *segmentation_function()* that takes input image and as many arguments as you need. Test your algorithm on the images given in Figure 2. Testing phase should be carried in a file named *the3_part2*. Your algorithm should output an image that shows the segmentation results (you can show each segment with a different color). Save these files as *the3_BX_output.png*.



(a) B1



(b) B2



(c) B3



(d) B4

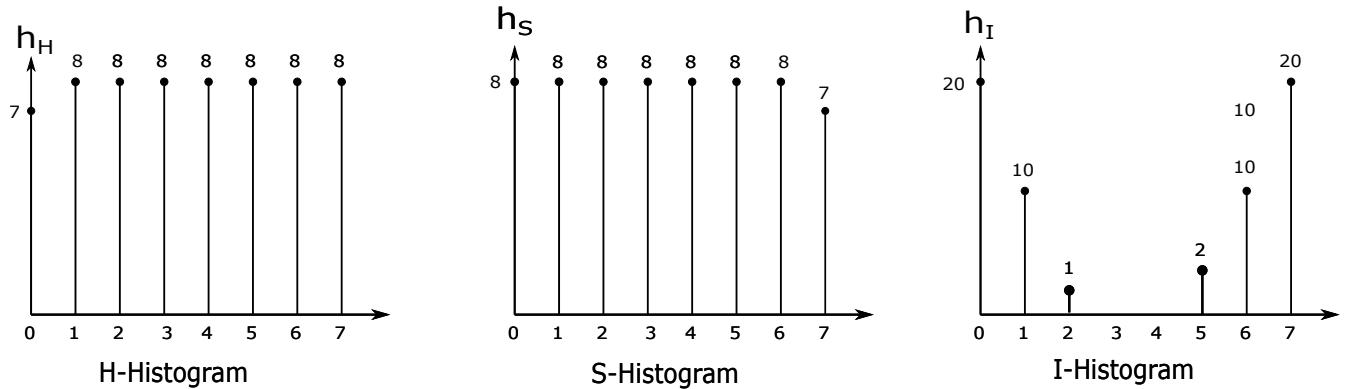


(e) B5

Figure 2: Images of part 2

Question 3 (20 Points) - Old Exam Question (Written)

Consider the following HSI histogram of 3 bit/pixel image.



- a) What is the size of this image?
- c) Suggest a segmentation algorithm, which uses an adaptive histogram thresholding method.
 - i) Give the pseudo code of your algorithm by specifying the method of estimating the threshold(s). What are the threshold values you obtain at the output of your algorithm for the original histograms, h_H , h_S , and h_I ?
 - ii) How many possible homogeneous regions in this image?

3 Regulations

1. **Group:** You are required to do your assignment in a group of two. If there is an unclear part in your code, we may ask any of the group member to describe that code segment. Also group members may get **different** grades. We reserve the right to evaluate some or all of the groups to determine the contribution of each group member to the assignment.
2. **Programming Language:** You must code your program in MATLAB or Python. You are expected make sure your code runs successfully on department lab machines.
3. **Late Submission:** Late Submission is **not** allowed!
4. **Newsgroup:** You must follow the odtuclass for possible updates on a daily basis.

4 Submission

Submission will be done via Odtuclass. Create a tar.gz file named THEX.tar.gz that contains all your source code files and the report as a PDF file. Do not send the input and output images. Only one member should submit the homework. Hence, do not forget to **write your names and student id's at the beginning of the scripts**.

5 Cheating

We have zero tolerance policy for cheating. People involved in cheating will be punished according to the university regulations.

Cheating Policy: Students/Groups may discuss the concepts among themselves or with the instructor or the assistants. However, when it comes to doing the actual work, it must be done by the student/group alone. As soon as you start to write your solution or type it, you should work alone. In other words, if you are copying text directly from someone else - whether copying files or typing from someone else's notes or typing while they dictate - then you are cheating (committing plagiarism, to be more exact). This is true regardless of whether the source is a classmate, a former student, a website, a program listing found in the trash, or whatever. Furthermore, plagiarism even on a small part of the program is cheating. Also, starting out with code that you did not write, and modifying it to look like your own is cheating. Aiding someone else's cheating also constitutes cheating. Leaving your program in plain sight or leaving your computer without logging out, thereby leaving your programs open to copying, may constitute cheating depending upon the circumstances. Consequently, you should always take care to prevent others from copying your programs, as it certainly leaves you open to accusations of cheating. We have automated tools to determine cheating. Both parties involved in cheating will be subject to disciplinary action. [Adapted from <http://www.seas.upenn.edu/cis330/main.html>]