Middle East Technical University Department of Computer Engineering

CENG 466

Fundamentals of Image Processing

Fall '2022-2023

Take Home Exam 4

Due date: January 4, 2023, Wednesday, 23:55

1 Specifications

You are given two noisy images, which you should denoise with your own algorithms. In addition to the solutions, you are required to prepare a report.

- Grading will be based on the quality of the outputs, script contents and the report
- The report should
  - be **maximum 10 pages** long and should be prepared in IEEE Conferance Proceedings Template (LaTeXis recommended) provided in the following link. `https://www.ieee.org/conferences_events/conferences/publishing/templates.html`
  - clearly explain the methodology and rationale behind the algorithm design.
  - explain the difficulties encountered in the design, implementation and experimentation stages, and your solutions on them.
  - contain analysis of the results, and your comments on the results. Even if the results does not match your expectations you should discuss the encountered situation.
  - contain information on requirements of your code (libraries etc.)
- **Implementation:** Write your solutions to *the4_solution.py*, you should structure the file similar to the one you are given in THE1.
- **Submission** Submission will be done via Odtuclass. Submit a single .zip file containing
  - the4_solution.py
  - Report

  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.**

2 Regulations

1. **Contribution to the Book:** The selected algorithms will be inserted to the book, "Fundamentals of Image Processing" by H. Mogultay, I. Onal and F.T. Yarman Vural with the consent of the owner students.

2. **Group:** You are required to do your assignment in a group of two students. 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.

3. **Programming Language:** You must code your program in Python. Your submission will be tested on department lab machines. You are expected make sure your code runs successfully on department lab machines.

4. **Late Submission:** Late Submission is penalized by -20 points/day.

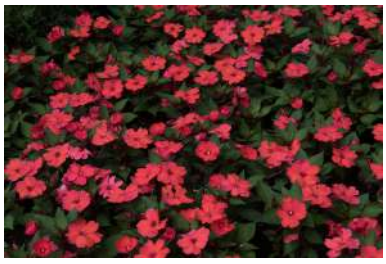
5. **Newsgroup:** You must follow the odtuclass for discussions and possible updates on a daily basis.

2.1 Question 1 (40 Points) - Object Counting

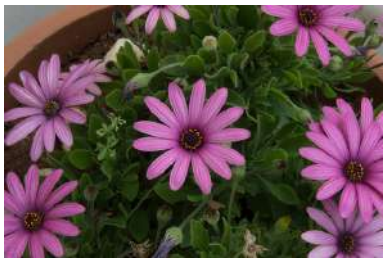
In this part, your task is to count the number of flowers in the images given in Figure 1. Your algorithm should output an image (*AX.png*) which shows the counted eggs. For this purpose you can provide a black and white image where the white pixel groups corresponds to the detected objects. Also your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

The number of flowers 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.



(a) A1.png



(b) A2.png

(c) A3.png

Figure 1: Images of Part 1

2.2 Question 2 (60 Points) - Segmentation

In this part, you will use mean shift and n-cut segmentations to segment the images given in Figure 2. Use at least 3 different parameter sets per algorithm and compare your results.

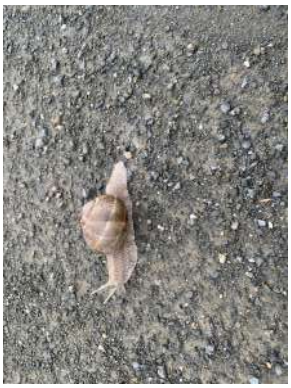
Your algorithm should output a single .png file containing 5 subfigures shown side by side. The images in the subfigures should be as follows (you can use subfigures to save the results as a single file);

- Original Image
- Segmentation map (See chapter 13, Figure 2 for an example)
- Boundary overlay (See chapter 13, Figure 3 for an example)
- Tree relationship structure (See chapter 13, Figure 52 for an example)
- Region adjacency graph (See chapter 13, Figure 58 for an example)

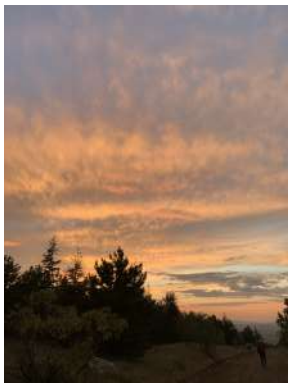
Save the above result as *BX_algorithm_Y_parameterset_Z.png*, where X is the number of image, Y is either *meanshift* or *ncut* and Z is either 1,2 or 3 representing the parameter set (i.e. you should produce 12 .png files each containing 5 subfigures) .

In this part, you are free to use any of the methods that you have learned so far for preprocessing and post processing.

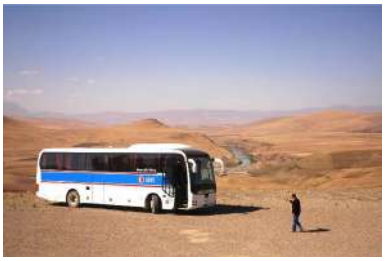
Explain your work in detail. And compare the results from mean shift segmentation and n-cut segmentation.



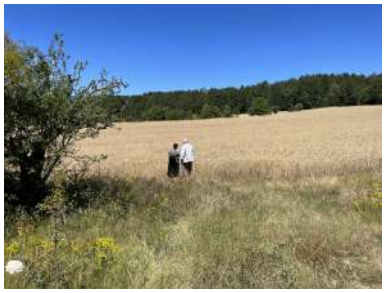
(a) B1



(b) B2



(c) B3



(d) B4

Figure 2: Images of part 2

3 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 asistants. 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 nots 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 thrash, 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]