Middle East Technical University Department of Computer Engineering

CENG 466 Fundamentals of Image Processing

Fall '2022-2023

Take Home Exam 1

Due date: November 7 2022, Monday , 23:55

1 Specifications

You are given two questions, which you should solve 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 3 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:** You are provided a template solution file (*the1_solution.py*), you should fill in the functions provided. You can define any additional functions if necessary.
- **Submission** Submission will be done via Odtuclass. Submit a single .zip file containing
  - the1_solution.py
  - Outputs folder
  - 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. **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.

2. **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.

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

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

a1 a2

Figure 1: Images to be rotated. Notice that the two images are the same image scaled to different sizes.

3 Affine Transformation (50 Points)

In this part your task is to rotate a given image (See Figure 1-a1,a2). Notice that 1-a1 is a scaled version of 1-a2 In order to complete this task, follow the given steps:

Step 1: Read the given image. (function read_image)

Step 2: Define a rotation function (function rotate_image), that takes an image as input and rotates it based on its degree and interpolation type.

Step 3: Define a function that writes the input image with a given name. (function write_image)

Step 4: Rotate,

- a1.png 45 degrees using Linear Interpolation (save the output as **./Outputs/a1_45_linear.png**)
- a1.png 45 degrees using Cubic Interpolation (save the outputas **./Outputs/a1_45_cubic.png**)
- a1.png 90 degrees using Linear Interpolation (save the outputas **./Outputs/a1_90_linear.png**)
- a1.png 90 degrees using Cubic Interpolation (save the output as **./Outputs/a1_90_cubic.png**)
- a2.png 45 degrees using Linear Interpolation (save the output as **./Outputs/a2_45_linear.png**)
- a2.png 45 degrees using Cubic Interpolation (save the outputas **./Outputs/a2_45_cubic.png**)

Step 5: Report and discuss your findings.

Figure 2: Source image for histogram equalization

4 Histogram Equalization (50 Points)

In this part you will implement histogram equalization algorithm on a gray-scale image. In order to complete this task follow the given steps:

Step 1: Read the image b1.png (See 2. Note that the images will be provided in gray-scale.

Step 2: Extract the histogram of the given image. Save this histogram as an image to ***'./Outputs/original_histogram.png'***.

Step 3: Equalize the histogram of the image. Save this histogram as an image to ***'./Outputs/equalized_histogram.png'***.

Step 4: Save the enhanced image as ***'./Outputs/enhanced_image.png'***.

Step 5: Report and discuss your findings.

BONUS : (15 Points) Apply adaptive histogram equalization on the same image. Follow the same steps as above.

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 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]