

Homework Assignment 1

Digital Image Processing

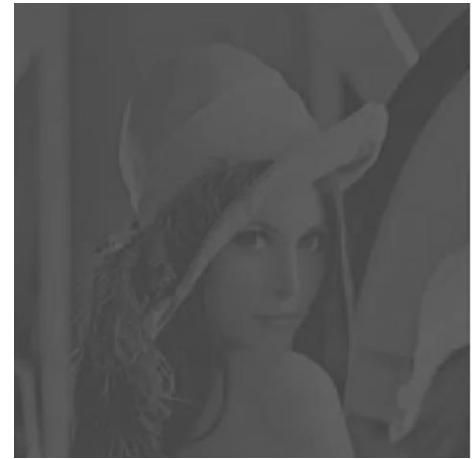
Fall 2022

Problem 1

- Prove that applying a 2-D transform with separable, symmetric kernels to an image can be implemented by: 1) computing a 1-D transform along the individual rows (columns) of the image and 2) computing another 1-D transform along the columns (rows) of the resulting image obtained in Step 1.

Problem 2

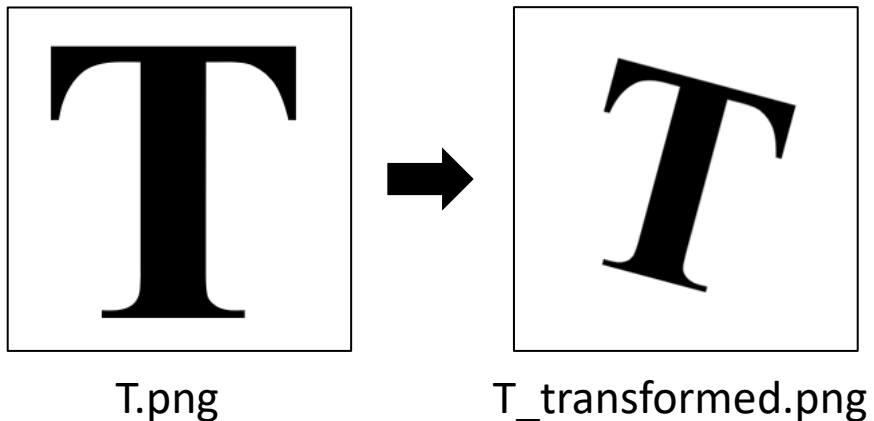
- Write a program in Python that implements gamma correction and histogram equalization as two separate methods to improve the contrast and brightness of image_2.png. Your program will be tested and evaluated.
- What is the gamma value that leads to minimal difference between the results of these two methods?



image_2.png

Problem 3

- Write a program in Python to resize and rotate an image using three different interpolation schemes: nearest neighbor interpolation, bilinear interpolation, and bicubic interpolation. Your program will be tested and evaluated.
- Find the transformation that registers T.png with T_transformed.png.



Problem 4

- Write a program in Python that takes an image like Fig. 3.42(a) as input and generates the shading pattern like the one in Fig. 3.42(b) and the shade removal result like Fig. 3.42(c). Your program will be tested and evaluated.
- Identify the root cause that makes the bottom right corner appear dark in Fig. 3.42(b).



a b c

FIGURE 3.42 (a) Image shaded by a shading pattern oriented in the -45° direction. (b) Estimate of the shading patterns obtained using lowpass filtering. (c) Result of dividing (a) by (b).

Software Package Allowed

- Python 3.8+
- Standard Python library
- Numpy 1.21.1
- Opencv-python 4.5.1

Assignment Requirements

- Only the Image IO of the Software Package is allowed, other image operations (interpolation, filtering, etc.) should be written by yourself.
- Set your directory structure as follows:
 - R109XXXXX/
 - p2.py
 - p3.py
 - p4.py
 - report.pdf
 - images/
 - image_2.png, image_4.tif, T.png, T_transformed.png
 - Images of program output

Assignment Submission Requirements

- Submit to **NTU COOL**
- Deadline: 09:00 AM, Monday, 10/3/2022
- Do NOT copy homework (code, report, results, etc.) from others

Grading Policy

- Problem 1 (15%)
- Problem 2 (30%)
 - 15%, if the code generates correct result
 - 15%, if the gamma value is correct
- Problem 3 (30%)
 - 15%, if the code generates correct result
 - 15%, if the transformation is correct
- Problem 4 (25%)
 - 20%, if the code generates correct result
 - 5%, if your answer is correct