EN2550 Assignment 1 on Intensity Transformations and Neighborhood Filtering

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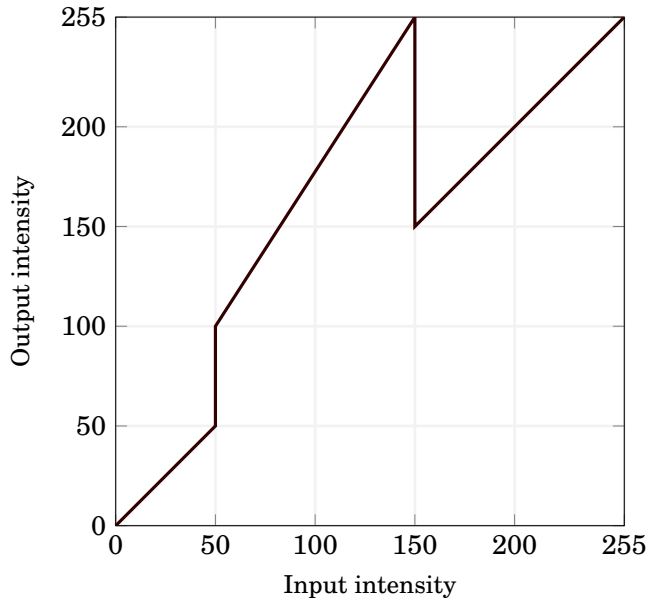
1. Implement the intensity transformation depicted in Fig. 1a on the image shown in Fig. 1b. **[2]**



(a) Intensity transformation.

(b) Image for intensity transformation.

2. Apply a similar operation as above (question 1) to accentuate

   (a) white matter

   (b) gray matter

   in the brain proton density image shown in Fig. 2. Show the intensity transformations as a plots. **[2]**

Figure 2: A brain proton density slice.

3. Consider the image shown in Fig. 3[1]. **[3]**

   (a) Apply gamma correction to the L plane in the $L^*a^*b^*$ color space and state the γ value.

   (b) Show the histograms of the original and corrected images.

Figure 3: Image for gamma correction.

4. Write a function of your own to carry out histogram equalization on the image shown in Fig. 4. Show the histograms before and after equalization. **[3]**

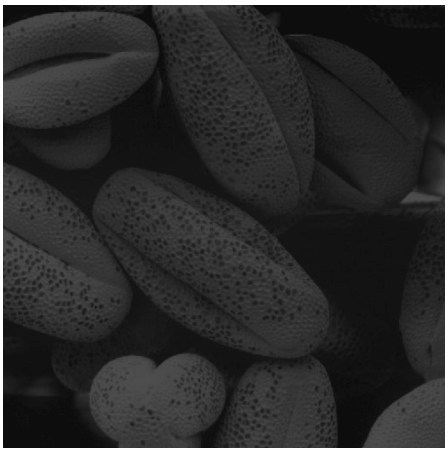


Figure 4: Image for histogram equalization.

5. Write a program to zoom images by a given factor $s \in (0, 10]$. You must use a function to zoom the image, which can handle

   (a) nearest-neighbor, and

   (b) bilinear interpolation.

   I have included four images, two large originals, and there zoomed-out versions. Test you algorithm by computing the normalized sum of squared difference (SSD) when you scale-up the given small images by a factor of 4 by comparing with the original images. **[3]**

6. Filtering with the Sobel operator can compute the gradient. Consider the image shown in Fig. 5 **[3]**

   (a) Using the existing filter2D to Sobel filter the image.

   (b) Write your own code to Sobel filter the image.

   (c) Using the property

$$\begin{bmatrix} 1 & 0 & -1 \\ 2 & 0 & -2 \\ 1 & 0 & -1 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & -1 \end{bmatrix},$$

   carry out Sobel filtering.

7. Fig. 6[2] shows a flower image with both the foreground and background are in focus. **[4]**

[1] https://www.adobe.com/creativecloud/photography/discover/highlights-and-shadows.html
[2] https://steemit.com/marguerite/ctrl-alt-nwo/marguerite-daisy

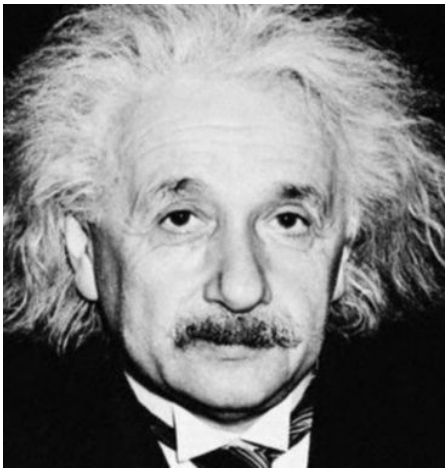


Figure 5: Image for Sobel filtering.

(a) Use grabCut to segment the image. Show the final segmentation mask, foreground image, and background image.

(b) Produce an enhanced image with a substantially blurred background. Display the original image alongside the enhanced image.

(c) Why is the background just beyond the edge of the flower quite dark in the enhanced image?

Figure 6: Image enhancing.

GitHub Profile

You must include the link to your GitHub (or some other SVN) profile, so that I can see that you have worked on this assignment over a reasonable duration. Therefore, make commits regularly. However, I will use only the pdf for grading to save time.

Submission

Upload a report (eight pages or less) named as your_index_a01.pdf. Include the index number and the name within the pdf as well. The report must include important parts of code, image results, and comparison of results. The interpretation of results and the discussion are important in the report. Extra-page penalty is 2 marks per page.