BIRZEIT UNIVERSITY
Computer Science Department

COMP339 Image Processing and Pattern Recognition

Spring Term 2023/2024

Image Processing Assignment: Exploring Lena

Submission Due Date April 5th 2024

This assignment is designed to introduce you to fundamental image processing techniques using the popular "Lena" image. Through these tasks, you'll gain hands-on experience with manipulating and analyzing digital images.

The Task:

You'll be working with an image named "lena.jpg," a colorful image with a size of 512x512 pixels. Your job is to perform various image-processing operations on it.

The Operations:

1. **Color to Grayscale & Binary Conversion:**
    - Start by converting the original color image into two different representations:
        - **Grayscale:** This removes color information, resulting in an image with shades of gray.
        - **Binary:** This simplifies the image even further, consisting only of black and white pixels.
2. **Downscaling:**
    - You have to reduce the size of the grayscale image from 512x512 to 256x256 pixels. This is a common technique for optimizing image storage and processing efficiency.
3. **Image Analysis:**
    - You will delve deeper into the grayscale image by calculating:
        - **Mean:** The average intensity value of all pixels in the image.
        - **Standard Deviation (STD):** A measure of how spread out the pixel intensities are.
        - **Entropy:** A measure of the randomness or information content in the image.
        - **Histogram:** A graphical representation that shows the frequency of each intensity level in the image.
            - **Normalized Histogram:** The histogram scaled to show the probability of each intensity level.

        - **Cumulative Histogram:** Shows the cumulative distribution of intensity values.

4. **Contrast Enhancement:**
    - You have to adjust the contrast of the grayscale image by 50%. This can improve the visibility of details by increasing the difference between light and dark regions. The resulting image will be saved as "(C)".
5. **Flipping and Blurring:**
    - You have to create a mirrored version of the grayscale image, essentially flipping it horizontally. This flipped image will be saved as "flipped.jpg."
    - You have also to apply a blurring filter to the grayscale image, softening sharp edges and reducing noise. The blurred image will be saved as "blured.jpg."
6. **Negative Image:**
    - You have to invert the grayscale image's intensity values, creating a negative version where light areas become dark and vice versa. The negative image will be saved as "negative.jpg."
7. **Custom Crop Function:**
    - You'll implement a function called "Crop" that allows you to extract a specific rectangular region from the image. This function will take four parameters:
        - **x:** Starting horizontal position (leftmost point) of the crop region.
        - **y:** Starting vertical position (topmost point) of the crop region.
        - **w:** Width of the cropped image.
        - **h:** Height of the cropped image.
8. **Histogram-based Search:**
    - Using the "Crop" function, you'll extract a vertical strip from the original grayscale image (imagine a thin slice). Then, you'll implement a search method based on the histogram that helps you find this specific strip within the entire grayscale image.

Deliverables:

- The original image with all the processed versions: grayscale, binary, downscaled, contrast-enhanced, flipped, blurred, negative.
- The implementation of the "Crop" function.
- The code demonstrating the histogram-based search for the cropped strip.

WORK INDIVIDUALLY AND SUBMIT YOUR WORK BEFORE THE DEADLINE