

## Image Processing Project

Team No. ( )

| No. | Team Member | Id | Grade |
|-----|-------------|----|-------|
| 1   |             |    |       |
| 2   |             |    |       |
| 3   |             |    |       |
| 4   |             |    |       |
| 5   |             |    |       |
| 6   |             |    |       |
| 7   |             |    |       |
| 8   |             |    |       |
| 9   |             |    |       |
| 10  |             |    |       |

**Design and implement a Python program with a graphical user interface (GUI) to perform the image operations listed in Table 1.**

**The following requirements must be met:**

### Custom Implementation:

- Write the code for each operation with relying on built-in functions that complete the entire process.
- Use basic operations like filter, sum, min, max, median, etc., to implement the functionality.

### User Interface Design:

- Ensure the GUI is aesthetically pleasing, with a consistent and visually appealing design in terms of layout, shapes, and colors.
- Group related operations (e.g., operations producing similar outcomes) into organized sections or boxes for better user experience.

### Functionality and Workflow:

- Start with a button to upload an image from the user's device. Display the uploaded image in a side frame within the program window.
- Provide buttons for each image operation. When clicked, the corresponding process should be applied, and the result displayed dynamically.

### Encourage Creativity:

- Add any creative features or enhancements that would increase the overall value and usability of the program.

*Table 1. Project Processes*

| Process                                      | Detailed Description  | Grade |
|--|---|-------|
| Image Reading                                | • Upload a colored image.   |       |
|  | • Display image information: resolution, size, and type.  |       |
| Grayscale Conversion                         | • Convert the uploaded image into a grayscale image.  |       |
| Binary Image Conversion                      | <ul style="list-style-type: none"> <li>• Convert the grayscale image to binary.</li> <li>• Implement a function that calculates the threshold using the average pixel intensity.</li> <li>• Evaluate whether this threshold is optimal or not.</li> </ul> |       |
| Affine Transformations                       | • Apply translation.  |       |
|  | • Apply scaling.  |       |
|  | • Apply rotation.   |       |
|  | • Apply x-direction shear.  |       |
|  | • Apply y-direction shear.  |       |
| Image Interpolation (Resolution Enhancement) | • Resize image using nearest-neighbor interpolation.  |       |
|  | • Resize using bilinear interpolation.  |       |
|  | • Resize using bicubic interpolation.   |       |
| Image Operations                             | • Crop a selected region of the image.  |       |
| Histogram Analysis                           | <ul style="list-style-type: none"> <li>• Implement a function to compute the histogram of a grayscale image.</li> <li>• Assess whether the histogram is good or not and justify the answer.</li> </ul>  |       |
|  | • Apply histogram equalization.   |       |
| Low-Pass Filtering                           | • Apply a 19×19 Gaussian filter with $\sigma = 3$ .   |       |
|  | • Apply a 7×7 median filter.  |       |
| High-Pass Filtering                          | • Apply Laplacian filter (second derivatives).  |       |
|  | • Apply Sobel filter.   |       |
|  | • Apply gradient filter (first derivatives).  |       |



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|                              |   |  |
|------------------------------|---|--|
| Image Compression Techniques | • Apply Huffman coding.                     |  |
|                              | • Apply Golomb–Rice coding.                 |  |
|                              | • Apply Arithmetic coding.                  |  |
|                              | • Apply LZW coding.                         |  |
|                              | • Apply Run-Length coding (RLE).            |  |
|                              | • Apply Symbol-based coding.                |  |
|                              | • Apply Bit-plane coding.                   |  |
|                              | • Apply Block Transform coding (e.g., DCT). |  |
|                              | • Apply Predictive coding.                  |  |
|                              | • Apply Wavelet coding.                     |  |

**Note: Part of the grades will be on the questions for each member of the team, and the other part will be on the implementation of the project.**