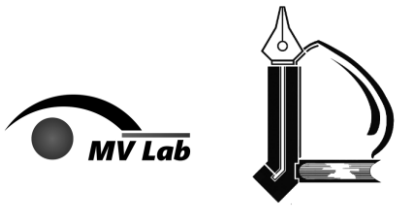

EXERCISE 1

Instructions The reports for the code base part should be written in a clear format and include the three sections as:

1- Technical description: Describe the idea and solution for solving problems in detail.
2- Describe results: Display and discuss the experimental results including table, images, etc.
3- Appendix: Code with **comments**, Reference, etc.

The reports for the Descriptive part should be written in a clear format and include the three sections as:

1- Clarity: Ensure your writing is clear, concise, and easy to understand.
2- Detail: Include specific examples and details.
3- Structure: Organize your answer in a logical and coherent manner.

Delivery

- All homework should be sent through **VU** (No Telegram, Email, etc.).
- The report in PDF format named “Number of Homework-First Name Last Name.pdf”.
- Notice the deadlines.

Points

- Any form of plagiarism will not be entertained and will result in a loss of grade.
- Never take screenshots of generated images.
- Try to clearly answer the questions.
- Discuss and comment on the obtained results.

1. In an edge detection algorithm, one common approach is to initially perform Gaussian smoothing on the image and subsequently apply the Laplacian filter. If we reverse this order and first apply Gaussian smoothing followed by the Laplacian filter, what distinctions emerge between the two approaches?

(Ensure that the reason behind the fact is explained, and include code-based calculation and results display for Lena image.)

2. What are the key distinctions between applying the first derivative test vertically and horizontally, and in what situations would you choose one over the other for specific use cases?

3. Apply histogram equalization to the provided image and represent the results after the equalization process.

image = [80, 110, 45, 150, 25, 70, 200, 95, 120, 30, 65, 175, 55, 40, 180]

4. Explore the utilization of wavelets in image compression and elaborate on the fundamental procedures within wavelet-based image compression, including processes like wavelet decomposition and quantization.

5. Write a program which can, firstly, down sample an image by a factor of 2, with and without using the averaging filter, and also, up-sample the previously down sampled images by a factor of 2, using the pixel replication and bilinear interpolation methods, respectively. (Lena image)

6. Write a program which, Compare the outcomes of applying the specified filters in both the frequency domain and the spatial domain. (Lena image)

A. $\begin{bmatrix} 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \end{bmatrix}$ B. $\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$ C. $\begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$

7. For the grayscale Lena image, manually compute a 3-level approximation pyramid and corresponding prediction residual pyramid. Use 2x2 averaging for the approximation and use pixel replication for the interpolation filters.

8. For the grayscale Lena Image, compute the wavelet transform (with 3-level) using the Haar analysis filters. Comment on the differences between the pyramids generated between this one and the previous question.

9. Implement the scaling transform using Bilinear Interpolation and Nearest-Neighbor Interpolation and compare the given results. (Lena image)