

# DIGITAL IMAGE AND VIDEO PROCESSING LAB - EXPERIMENT NO. 7

## MORPHOLOGICAL OPERATIONS

Submitted by Unnati Singh (21EC39027)

### Overview:

This experiment involves implementing basic morphological operations such as erosion, dilation, opening, and closing on binary images using various structuring elements. These operations are fundamental in image processing for tasks such as noise removal, shape extraction, and object detection.

### Files Included:

1. `Exp_07_21EC39027.py`: Python script containing modular functions for morphological operations using various structuring elements.
2. `Exp_07_21EC39027.ipynb`: Jupyter Notebook containing the same code for interactive execution and visualization of erosion, dilation, opening, and closing operations.
3. `Input/`: Folder containing the input binary image (`ricegrains_mono.bmp`) used in the experiment.
4. `Output/`: Folder containing the output images.
5. `Experiment_6.pdf`: PDF file containing the problem statement.
6. `README.pdf`: This README file.

### Functions Overview:

1. `ErodeBinary(image, element):`
  - **Purpose:** Perform erosion on a binary image using a given structuring element.
  - **Working:** Erosion shrinks objects in the image by removing boundary pixels according to the structuring element.
  - **Input:** Binary image and a structuring element (matrix).
  - **Output:** Eroded binary image.
2. `DilateBinary(image, element):`
  - **Purpose:** Perform dilation on a binary image using a given structuring element.
  - **Working:** Dilation expands objects in the image by adding boundary pixels according to the structuring element.

- **Input:** Binary image and a structuring element (matrix).
  - **Output:** Dilated binary image.
3. **OpenBinary(image, element):**
- **Purpose:** Perform opening operation on a binary image.
  - **Working:** Opening is erosion followed by dilation, often used to remove small objects or noise from the foreground.
  - **Input:** Binary image and a structuring element (matrix).
  - **Output:** Binary image after opening.
4. **CloseBinary(image, element):**
- **Purpose:** Perform closing operation on a binary image.
  - **Working:** Closing is dilation followed by erosion, typically used to close small holes or gaps in objects.
  - **Input:** Binary image and a structuring element (matrix).
  - **Output:** Binary image after closing.

### Structuring Elements:

Different structuring elements were used in the experiment, represented by matrices of 1s and 0s. These include:

1. **Structuring Element 1:** A 1x2 matrix of ones: `np.ones((1, 2))`
2. **Structuring Element 2:** A 3x3 matrix of ones: `np.ones((3, 3))`
3. **Structuring Element 3:** A cross-shaped matrix:  
`np.array([[0, 1, 0], [1, 1, 1], [0, 1, 0]])`
4. **Structuring Element 4:** A 9x9 matrix of ones: `np.ones((9, 9))`
5. **Structuring Element 5:** A 15x15 matrix of ones: `np.ones((15, 15))`

### Results:

The functions are visualized in the notebook by performing the morphological operations (erosion, dilation, opening, and closing) on the binary image `ricegrains_mono.bmp` using the different structuring elements.

Each operation is displayed side by side, showing the effect of the respective morphological operation with varying structuring elements.