

Computer Vision

Home Work 5

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Project – Mathematical Morphology on Grayscale Image.

Language and library used: Python, Pillow, Numpy.

Description: This program will perform the following functions while executing lena.bmp image file:

1. Dilation
2. Erosion
3. Opening
4. Closing

Parameters: None. Please Copy-paste the image path inside the program.

Algorithms Used –

Part 1: Dilation Morphology of Grayscale Image

Basic Formula =

$$(f \oplus b)(x) = \sup_{y \in E} [f(y) + b(x - y)],$$

Principal Code:

```
def grayscale_Dilation(image, Kernel):
    # Copy the Image Dimension
    dilated_Image = Image.new('L', image.size)
    # Centre value of the Kernel
    kernel_centre_point = tuple(x // 2 for x in Kernel.shape)
    # Iterating over each pixel in original image
    for h_row in range(row):
        for w_col in range(col):
            # Initialize local pixel value and record it
            localMaxPixel = 0
            # Iterating over Kernel Shape
            for K_row in range(Kernel.shape[0]):
                for K_col in range(Kernel.shape[1]):
                    # Get kernel value 1 from each iteration
                    if Kernel[K_row, K_col] == 1:
                        # Get the destination pixel location to be filled
                        n_row_val = h_row + (K_row -
kernel_centre_point[0])
                        n_col_val = w_col + (K_col -
kernel_centre_point[1])
                        # Avoiding out of range and putting the value 255
                        to destination pixel
                        if n_row_val < image.size[0] and n_col_val <
```

```

image.size[1]:
# Get pixel value from original image at
(n_row_val, n_col_val).
originalPixel = image.getpixel((n_row_val,
n_col_val))
# Update local max. pixel value.
localMaxPixel = max(localMaxPixel,
originalPixel)
# Paste minimum local pixel value on original image.
dilated_Image.putpixel((h_row, w_col), localMaxPixel)
# Return dilated image.
return dilated_Image

```

Part 2: Erosion Morphology of Grayscale Image

Basic Formula =

$$(f \ominus b)(x) = \inf_{y \in B} [f(x + y) - b(y)]$$

Principal Code:

```

def grayscale_Erosion(image, Kernel):
    # Copy the Image Dimension
    eroded_Image = Image.new('L', image.size)
    # Centre value of the Kernel
    kernel_centre_point = tuple(x // 2 for x in Kernel.shape)
    # Iterating over each pixel in original image
    for h_row in range(0, row):
        for w_col in range(0, col):
            # Initialize local pixel value and record it
            localMinPixel = 255
            # Iterating over Kernel Shape
            for K_row in range(0, Kernel.shape[0]):
                for K_col in range(0, Kernel.shape[1]):
                    # Get kernel value 1 from each iteration
                    if Kernel[K_row, K_col] == 1:
                        # Get the destination pixel location to be filled
                        out
                        n_row_val = h_row + (K_row -
kernel_centre_point[0])
                        n_col_val = w_col + (K_col -
kernel centre point[1])
                        # Avoiding out of range and putting the value 255
                        to destination pixel
                        if n_row_val < image.size[0] and n_col_val <
image.size[1]:
                            # Get pixel value from original image at
                            (n_row_val, n_col_val).
                            originalPixel = image.getpixel((n_row_val,
n_col_val))
                            # Update local max. pixel value.
                            localMinPixel = min(localMinPixel,
originalPixel)
                            # Paste minimum local pixel value on original image.
                            eroded_Image.putpixel((h_row, w_col), localMinPixel)
                        # Return eroded image.
                        return eroded_Image

```

Part 3: Opening Morphology of Grayscale Image

Basic Formula-

$$f \circ k = (f \ominus k) \oplus k$$

Principal Code –

```
def grayscale_Opening(image, Kernel):  
    return grayscale_Dilation(grayScale_Erosion(image, Kernel), Kernel)
```

Part 4: Closing Morphology of Grayscale Image

Basic Formula –

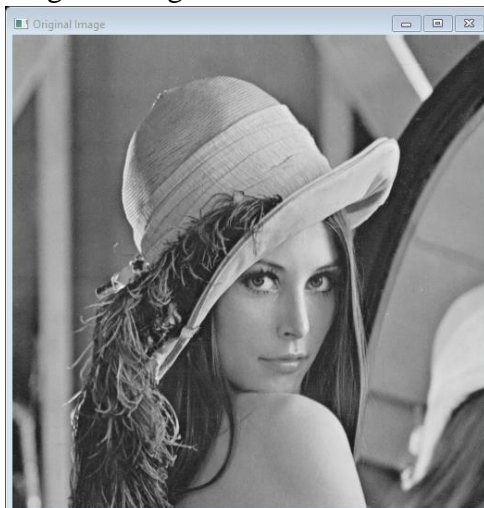
$$f \bullet k = (f \oplus k) \ominus k$$

Principal Code-

```
def grayscale_Closing(image, Kernel):  
    return grayscale_Erosion(grayScale_Dilation(image, Kernel), Kernel)
```

Example:

- Original image



- Dilation of Grayscale Image



- Erosion of Grayscale Image



- Opening Morphology of Grayscale Image



- Closing Morphology of Grayscale image

