

## 7 - 8.6. Dilation and Erosion

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### 1 Introduction

In Geometric Transformations, the dilation and erosion are two fundamental operations. They are used to enlarge or shrink the foreground object in an image. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The thickness or size of the object increases or decreases after dilation and erosion.

### 2 Setup

```
[ ]: %pip install opencv-python opencv-contrib-python numpy matplotlib
```

### 3 Initial Setup

```
[1]: # Import Libraries
import os
import cv2
import numpy as np
import matplotlib.pyplot as plt

# Asset Root
asset_root = os.path.join(os.getcwd(), '../..assets')

# Image Path
image_path = os.path.join(asset_root, 'images', 'random_noisy_image.png')

# Read Image and convert to RGB
input_image = cv2.cvtColor(cv2.imread(image_path), cv2.COLOR_BGR2RGB)

# Display Both Image
plt.figure("Dilation and Erosion", figsize=(10, 10))

plt.imshow(input_image)
```

```
plt.title("Original Image")  
plt.axis('off')  
  
plt.show()
```

Original Image



## 4 Dilation and Erosion in Images

To perform dilation and erosion in an image, we need to define a **kernel**. The **kernel** is a matrix that slides over the image. The **kernel** is a binary matrix with **ones** and **zeros**. The **ones** in the **kernel** are called the **structuring element**. The **structuring element** is the pixel that is considered for the operation. The **structuring element** is placed on the center of the **kernel**. The **kernel** slides over the image, and the center of the **kernel** is placed on the pixel

of the image. The pixel of the image is considered for the operation if the center of the kernel is on the pixel. The dilation and erosion operations are performed based on the structuring element.

Below is the structuring element with ones and zeros for a 5x5 kernel.

$$\begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

```
[2]: # Set Kernel
kernel_size = (5, 5)
kernel = np.ones(kernel_size, np.uint8)

# Erode the Image
eroded_image = cv2.erode(input_image, kernel, iterations=1)

# Dilate the Image
dilated_image = cv2.dilate(input_image, kernel, iterations=1)

# Erosion and Dilation
dilation_erosion_image = cv2.dilate(eroded_image, kernel, iterations=1)

# Display All Images
plt.figure("Dilation and Erosion", figsize=(15, 15))

plt.subplot(2, 2, 1)
plt.imshow(input_image)
plt.title("Original Image")
plt.axis('off')

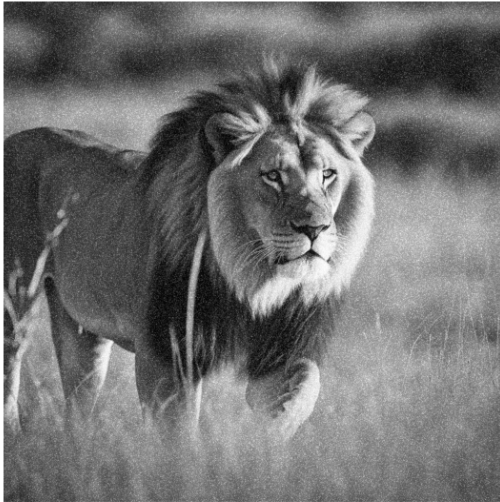
plt.subplot(2, 2, 2)
plt.imshow(eroded_image)
plt.title("Eroded Image")
plt.axis('off')

plt.subplot(2, 2, 3)
plt.imshow(dilated_image)
plt.title("Dilated Image")
plt.axis('off')

plt.subplot(2, 2, 4)
plt.imshow(dilation_erosion_image)
plt.title("Dilation and Erosion")
plt.axis('off')
```

```
plt.show()
```

Original Image



Eroded Image



Dilated Image



Dilation and Erosion



In the above example, we have performed **dilation** and **erosion** operations on the image. The **structuring element** is a 5x5 matrix with **ones** and **zeros**. The **erosion** operation is performed first, followed by the **dilation** operation. The **dilation** operation is performed on the **eroded** image. The **dilation** and **erosion** operations are performed based on the **structuring element**. The **thickness** or **size** of the object increases or decreases after **dilation** and **erosion**.

In **OpenCV**, the **cv2.erode** and **cv2.dilate** functions are used to perform **erosion** and **dilation** operations. The **cv2.erode** function is used to perform the **erosion** operation, and the **cv2.dilate** function is used to perform the **dilation** operation. The **kernel** is passed as an argument to the **cv2.erode** and **cv2.dilate** functions.

## 5 Summary

- Dilation and Erosion are two fundamental operations in Geometric Transformations.
- Dilation adds pixels to the boundaries of objects in an image.
- Erosion removes pixels on object boundaries.
- The kernel is a matrix that slides over the image.
- The structuring element is the pixel that is considered for the operation.
- The structuring element is placed on the center of the kernel.
- The dilation and erosion operations are performed based on the structuring element.
- The thickness or size of the object increases or decreases after dilation and erosion.

### Read More:

- [Dilation and Erosion](#)
- [Dilation](#)
- [Erosion](#)

## 6 References

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