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`.

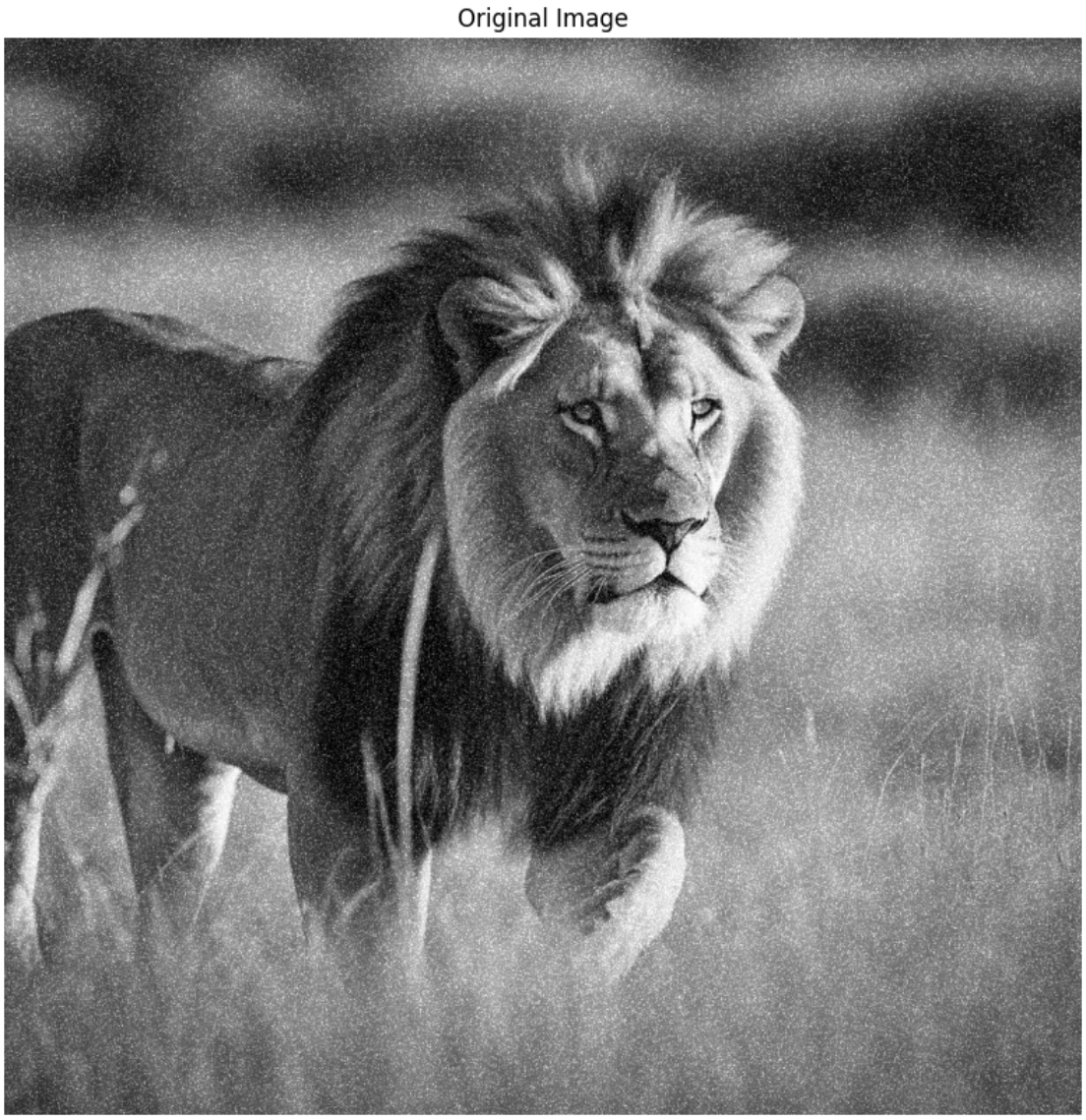
2 Setup

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

3 Initial Setup

[44]:
```
# 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()
```



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`

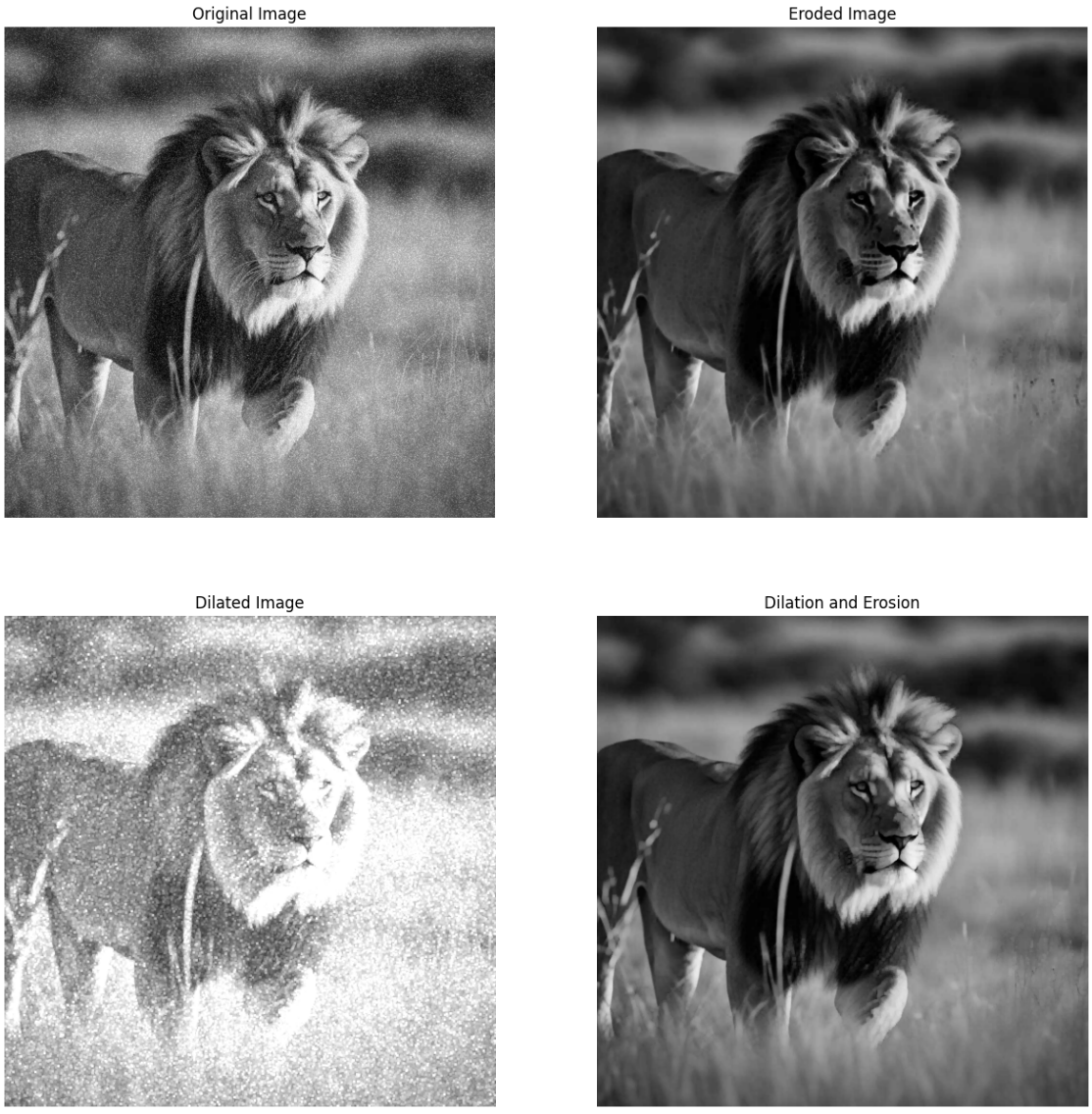
of the image. The `pixel` of the image is considered for the operation if the `center` of the `kernel` is on the `pixel`. The `dilation` and `erosion` operations are performed based on the `structuring element`.

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

$$\begin{bmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{bmatrix}$$

[51]:
```
# 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()
```



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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