Computer Vision

Experiment No. 03

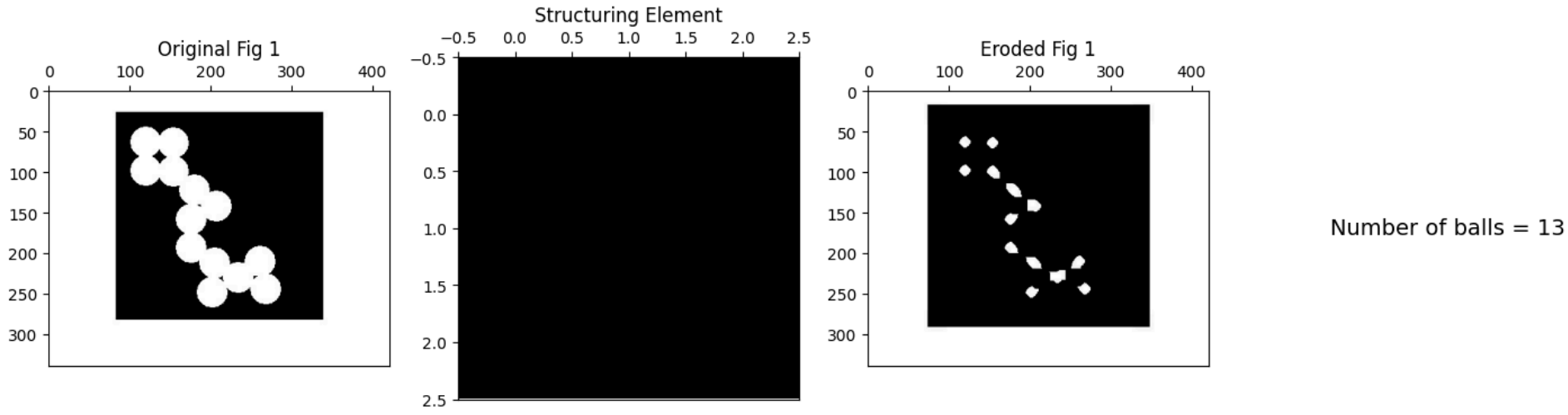
Name of the Experiment: To perform morphological operations.

Performed on: 23 January 2025

Import libraries

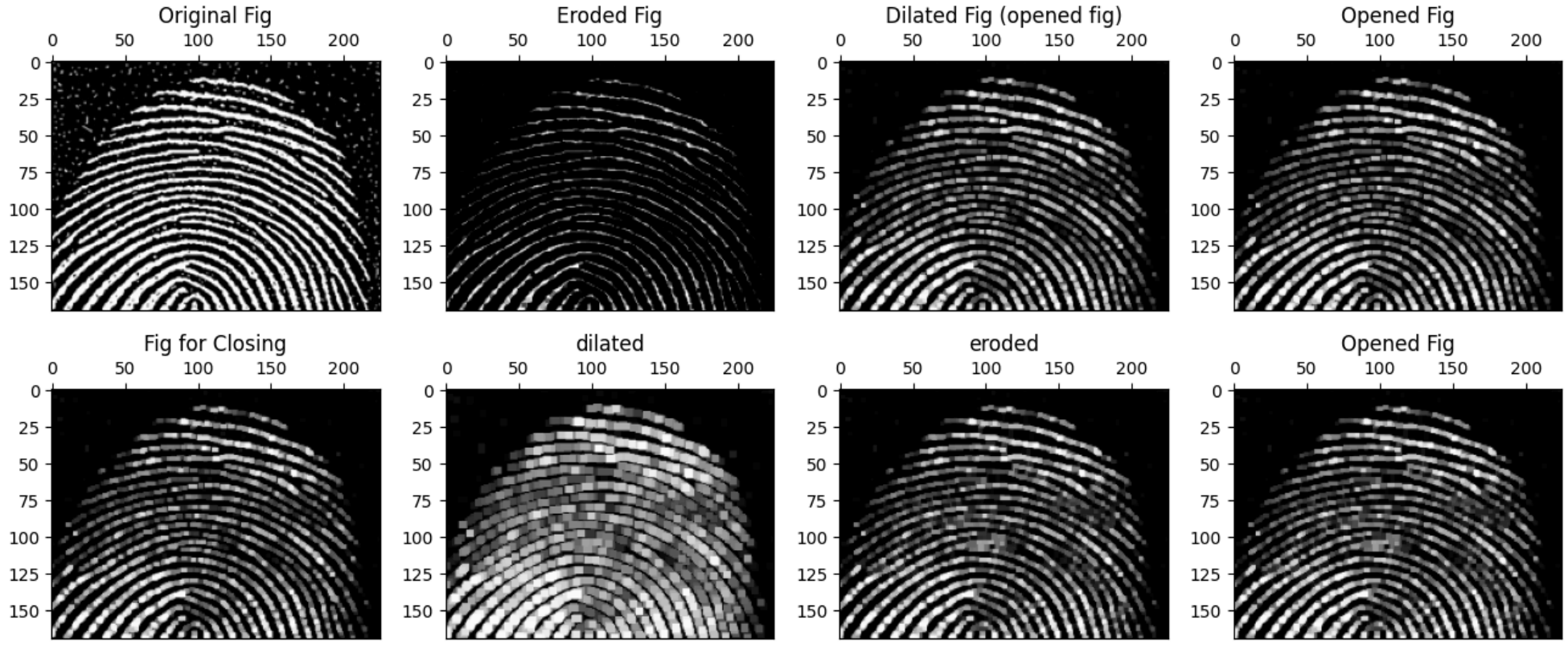
```
import cv2
import numpy as np
import matplotlib.pyplot as plt


# Load images
img1 = cv2.imread('/content/WhatsApp Image 2025-01-23 at 9.11.05 AM.jpeg', cv2.IMREAD_GRAYSCALE)  # Load as grayscale
img2 = cv2.imread('/content/WhatsApp Image 2025-01-23 at 9.06.01 AM.jpeg')  # Load color image (not used in this task)
img3 = cv2.imread('/content/WhatsApp Image 2025-01-23 at 9.00.17 AM (1).jpeg')  # Load color image (not used in this tas

# Define structuring elements
kernel = cv2.getStructuringElement(cv2.MORPH_RECT, (3, 3))  # 3x3 rectangular kernel


# Lab Task 1: Perform erosion to separate balls in Fig 1
eroded_fig1 = cv2.erode(img1, kernel, iterations=9)

# Connected component analysis to count the balls
num_labels, labels = cv2.connectedComponents(eroded_fig1)

# Display Lab Task 1 results
plt.figure(figsize=(18, 4))

plt.subplot(1, 4, 1)
plt.title("Original Fig 1")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(img1, cmap='gray')

plt.subplot(1, 4, 2)
plt.title("Structuring Element")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(kernel, cmap='gray')

plt.subplot(1, 4, 3)
plt.title("Eroded Fig 1")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(eroded_fig1, cmap='gray')

plt.subplot(1, 4, 4)
plt.axis('off')
plt.text(0.5, 0.5, f"Number of balls = {num_labels-1}", fontsize=14, ha='center', va='center')
```

```
Text(0.5, 0.5, 'Number of balls = 13')
```

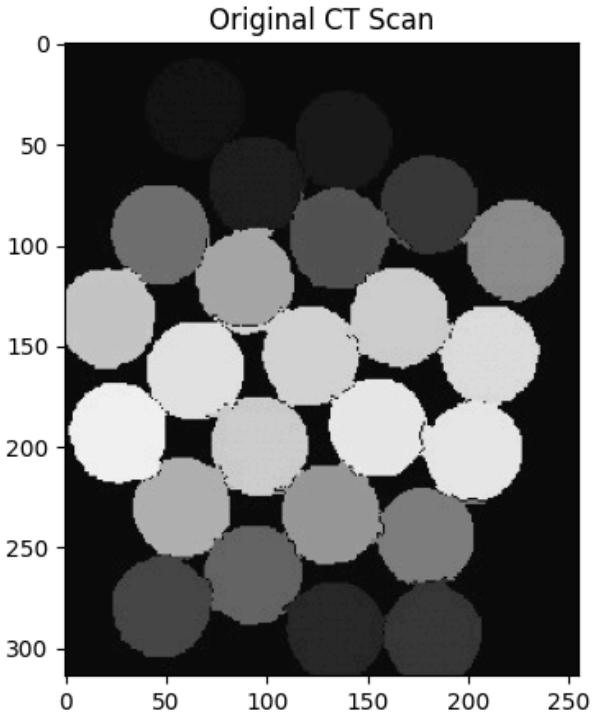


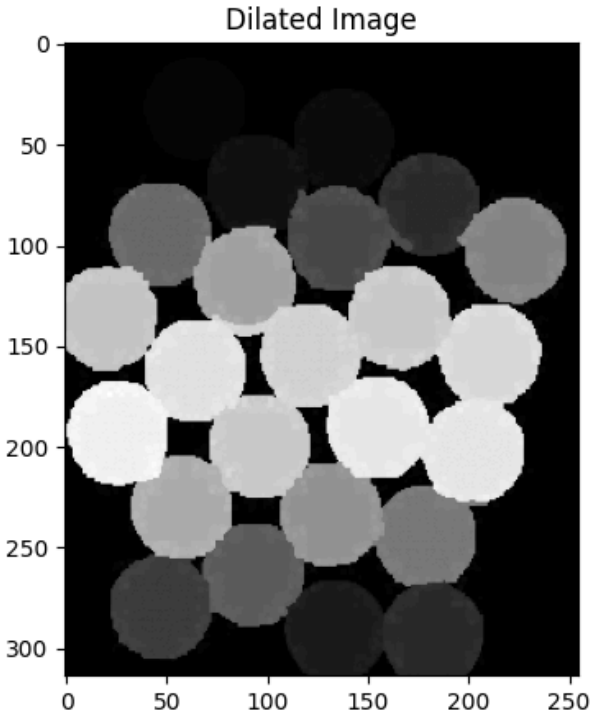
```
# Lab Task 2: Noise removal and gap filling on Fig 2
# Step 1: Remove noise using opening

eroded_fig = cv2.erode(img2, kernel, iterations=1)
dilated_fig = cv2.dilate(eroded_fig, kernel, iterations=1)
opened_fig = cv2.morphologyEx(img2, cv2.MORPH_OPEN, kernel)

plt.figure(figsize=(16, 4))

plt.subplot(1,4,1)
plt.title("Original Fig")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(img2, cmap='gray')

plt.subplot(1,4,2)
plt.title("Eroded Fig")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(eroded_fig, cmap='gray')

plt.subplot(1,4,3)
plt.title("Dilated Fig (opened fig)")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(dilated_fig, cmap='gray')


plt.subplot(1,4,4)
plt.title("Opened Fig")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(opened_fig, cmap='gray')


# Step 2: Fill gaps using closing

dilated_fig2 = cv2.dilate(dilated_fig, kernel, iterations=1)
eroded_fig2 = cv2.erode(dilated_fig2, kernel, iterations=1)
closed_fig = cv2.morphologyEx(dilated_fig, cv2.MORPH_CLOSE, kernel)

plt.figure(figsize=(16, 4))

plt.subplot(1, 4, 1)
plt.title("Fig for Closing")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(dilated_fig, cmap='gray')

plt.subplot(1, 4, 2)
plt.title("dilated")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(dilated_fig2, cmap='gray')

plt.subplot(1, 4, 3)
plt.title("eroded")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(eroded_fig2, cmap='gray')

plt.subplot(1,4,4)
plt.title("Opened Fig")
plt.gca().xaxis.set_ticks_position('top')
plt.imshow(closed_fig, cmap='gray')
```

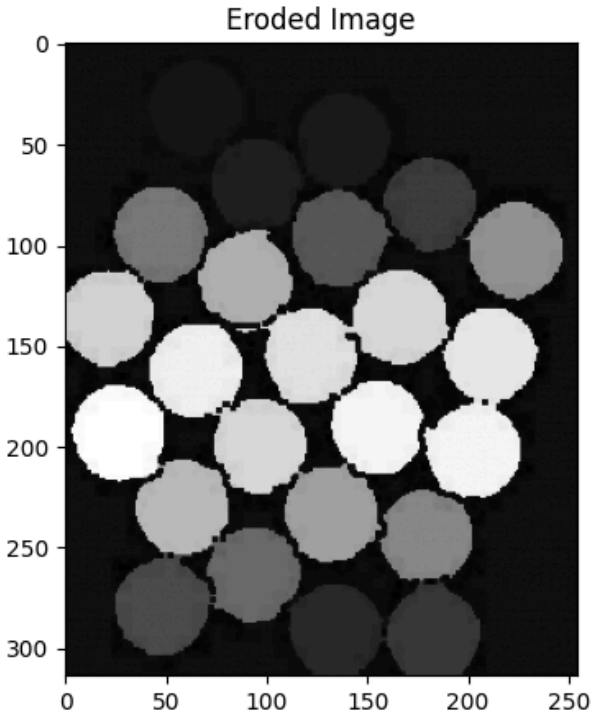
```
<matplotlib.image.AxesImage at 0x7ac2f9177810>
```

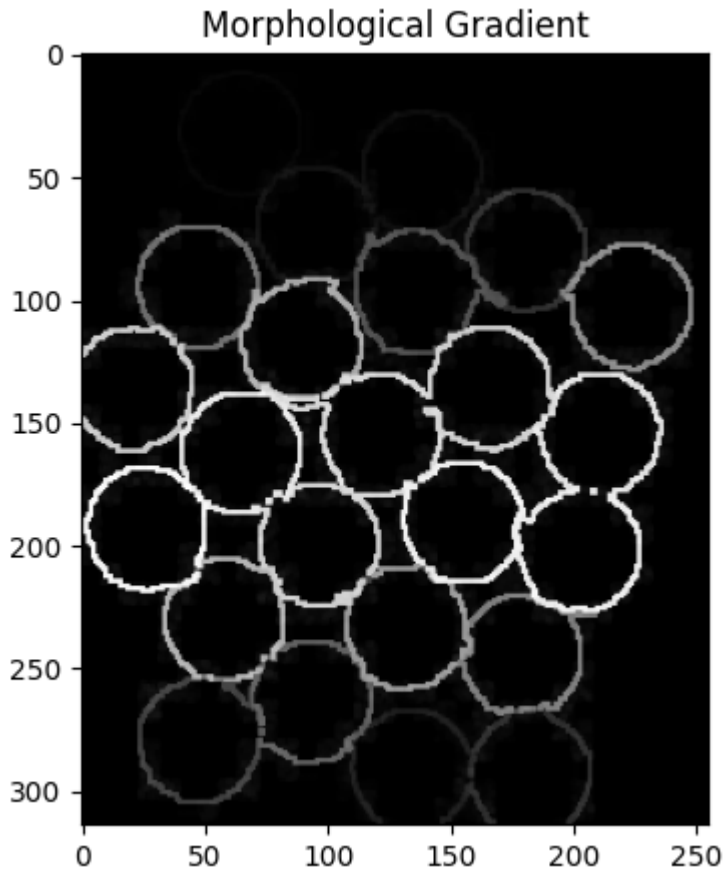



```
# Load CT scan image (grayscale)
image = cv2.imread("/content/WhatsApp Image 2025-01-23 at 9.00.17 AM (1).jpeg", 0)  # Update path if needed
# Define a structuring element (3x3 kernel)
kernel = cv2.getStructuringElement(cv2.MORPH_RECT, (3,3))

# Apply dilation
dilated = cv2.dilate(image, kernel, iterations=1)

# Apply erosion
eroded = cv2.erode(image, kernel, iterations=1)

# Compute morphological gradient (difference between dilation and erosion)
gradient = dilated - eroded

# Display results
plt.figure(figsize=(15,5))

plt.subplot(1,3,1)
plt.title("Original CT Scan")
plt.imshow(image, cmap='gray')

plt.subplot(1,3,2)
plt.title("Dilated Image")
plt.imshow(dilated, cmap='gray')

plt.subplot(1,3,3)
plt.title("Eroded Image")
plt.imshow(eroded, cmap='gray')

plt.figure(figsize=(5,5))
plt.title("Morphological Gradient")
plt.imshow(gradient, cmap='gray')

plt.show()
```


Original CT Scan
0
50
100
150
200
250
300
0
50
100
150
200
250


Dilated Image
0
50
100
150
200
250
300
0
50
100
150
200
250


Eroded Image
0
50
100
150
200
250
300
0
50
100
150
200
250


Morphological Gradient
0
50
100
150
200
250
300
0
50
100
150
200
250