Image processing & Machine Vision Assignment Report

Assignment - I

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D/ENG/22/0061/EE

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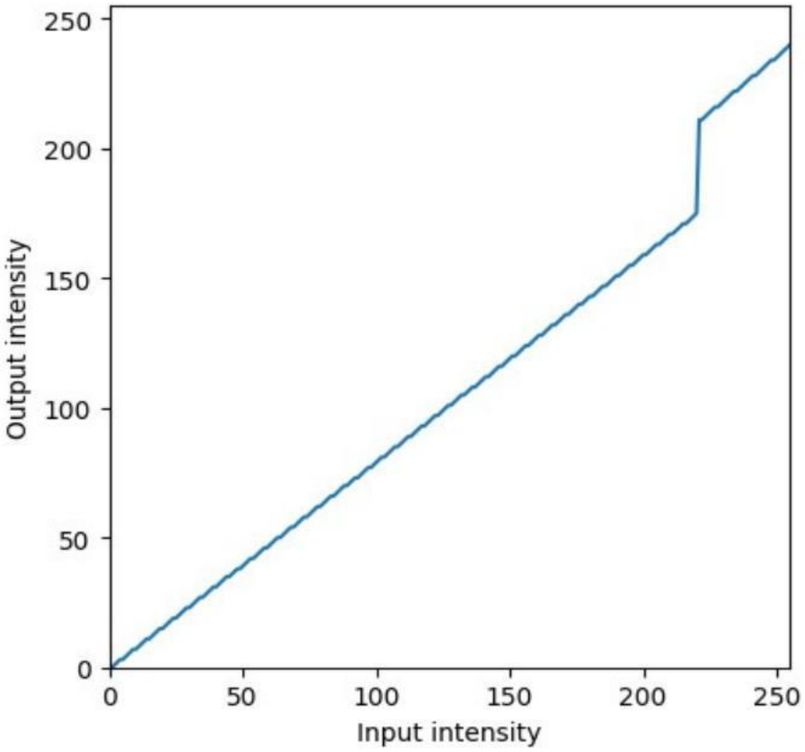
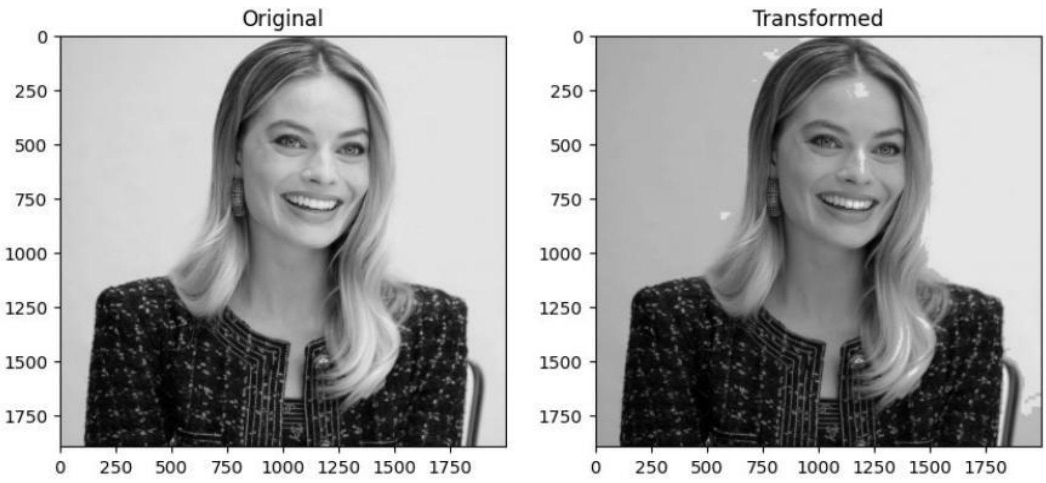
Content

Question 01

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

c = np.array([(220, 175), (220, 210), (255, 240)])

t1 = np.linspace(0, c[0, 1], c[0, 0]+1).astype('uint8')
print(len(t1))
t2 = np.linspace(c[0, 1] + 1, c[1, 0]-c[0, 0], c[1, 0]-c[0,
0]).astype('uint8')
print(len(t2))
t3 = np.linspace(c[1, 1] + 1, 240, 255 - c[1, 0]).astype('uint8')
print(len(t3))

transform = np.concatenate((t1, t2, t3), axis=0).astype('uint8')
print(len(transform))

fig, ax = plt.subplots()
ax.plot(transform)
ax.set_xlabel(r'Input intensity')
ax.set_ylabel('Output intensity')
ax.set_xlim(0, 255)
ax.set_ylim(0, 255)
ax.set_aspect('equal')
plt.show()

img_orig = cv.imread('margot_golden_gray.jpg', cv.IMREAD_GRAYSCALE)
image_transformed = cv.LUT(img_orig, transform)

fig, ax = plt.subplots(1, 2, figsize=(10, 20))
ax[0].imshow(img_orig, cmap="gray")
ax[0].set_title("Original")
ax[1].imshow(image_transformed, cmap="gray")
ax[1].set_title("Transformed")
plt.show()
```

```
221
0
35
256
```

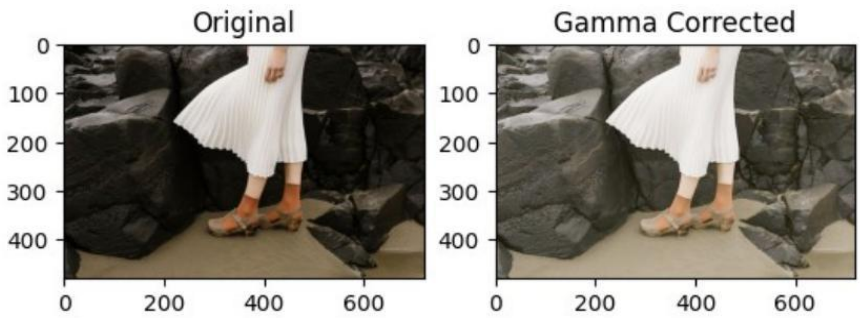

Output intensity
Input intensity
0
50
100
150
200
250


Original
Transformed
0
250
500
750
1000
1250
1500
1750

Question 02

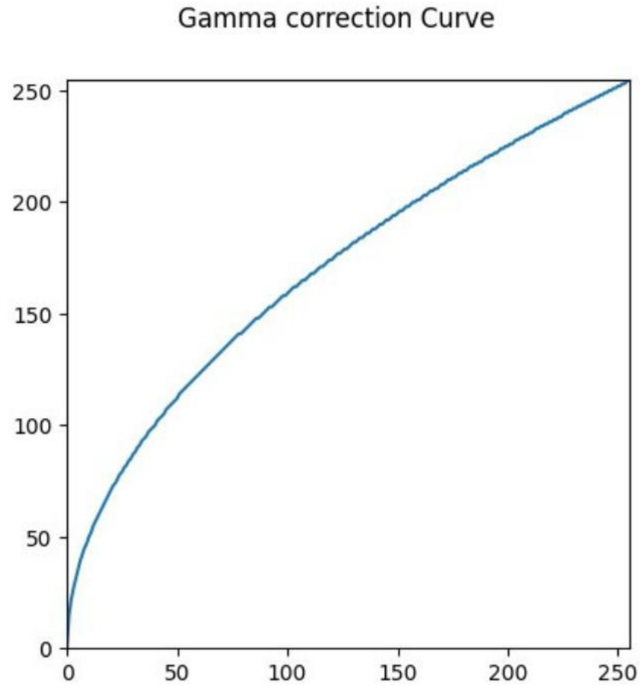
a.
```python
import cv2 as cv
import numpy as np
import matplotlib.pyplot as plt

img_orig = cv.imread('highlights_and_shadows.jpg', cv.IMREAD_COLOR)

gamma = .5

table = np.array(
    [(i/255.0)**(gamma)*255.0 for i in np.arange(0,
256)]).astype('uint8')

img_gamma = cv.LUT(img_orig, table)
img_orig = cv.cvtColor(img_orig, cv.COLOR_BGR2RGB)
img_gamma = cv.cvtColor(img_gamma, cv.COLOR_BGR2RGB)

f, axarr = plt.subplots(1, 2)
axarr[0].imshow(img_orig)
axarr[0].set_title('Original')
axarr[1].imshow(img_gamma)
axarr[1].set_title('Gamma Corrected')
```

```
Text(0.5, 1.0, 'Gamma Corrected')
```



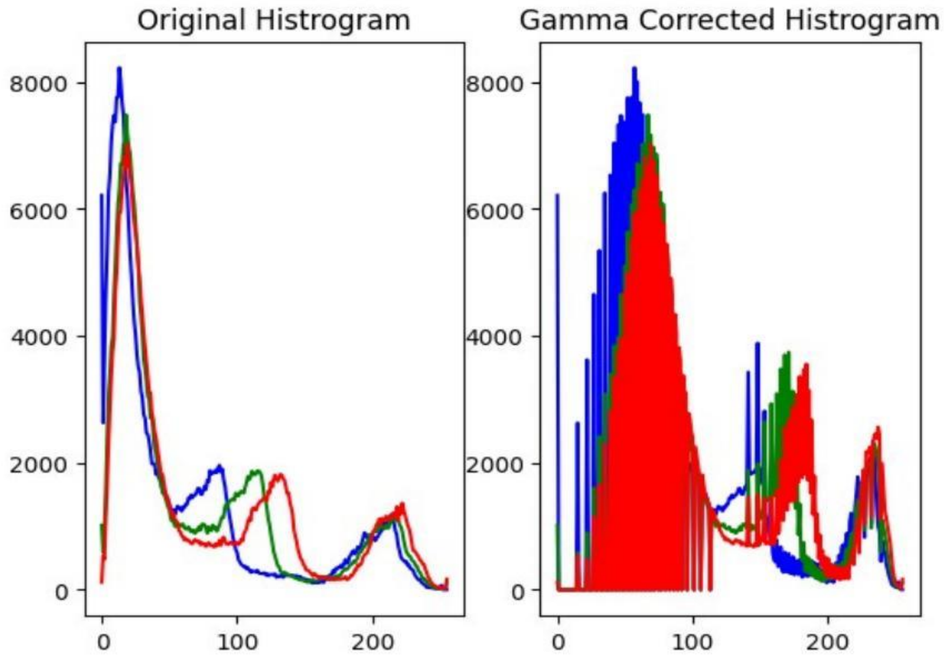

```python
import cv2 as cv
import numpy as np
import matplotlib.pyplot as plt

img_orig = cv.imread('highlights_and_shadows.jpg', cv.IMREAD_COLOR)

gamma = .5

table = np.array(
    [(i/255.0)**(gamma)*255.0 for i in np.arange(0,
256)]).astype('uint8')

img_gamma = cv.LUT(img_orig, table)
```

```
img_orig = cv.cvtColor(img_orig, cv.COLOR_BGR2RGB)
img_gamma = cv.cvtColor(img_gamma, cv.COLOR_BGR2RGB)

fig, axarr = plt.subplots()
axarr.plot(table)
axarr.set_xlim(0, 255)
axarr.set_ylim(0, 255)
axarr.set_aspect('equal')

plt.suptitle("Gamma correction Value Curve")
plt.show()
```



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

img = cv.imread('highlights_and_shadows.jpg', cv.IMREAD_COLOR)

gamma = .5

table = np.array(
    [(i/255.0)**(gamma)*255.0 for i in np.arange(0,
256)]).astype('uint8')
```

```python
img_gamma = cv.LUT(img_orig, table)
img_orig = cv.cvtColor(img_orig, cv.COLOR_BGR2RGB)
img_gamma = cv.cvtColor(img_gamma, cv.COLOR_BGR2RGB)

f, axarr = plt.subplots(1, 2)
color = ('b', 'g', 'r')

for i, c in enumerate(color):
    hist_orig = cv.calcHist([img_orig], [i], None, [256], [0, 256])
    axarr[0].plot(hist_orig, color=c)
    axarr[0].set_title('Original Histrogram')
    hist_gamma = cv.calcHist([img_gamma], [i], None, [256], [0, 256])
    axarr[1].plot(hist_gamma, color=c)
    axarr[1].set_title('Gamma Corrected Histrogram')
```



Question 03

a.

```python
import cv as cv
import numpy as np
import matplotlib.pyplot as plt

def f(x, a, sigma):
    return np.minimum(x + a * 128 * np.exp(-(x - 128) ** 2 / (2 * 
sigma ** 2)), 255)

image = cv.imread("spider.png")
hsv_image = cv.cvtColor(image, cv.COLOR_BGR2HSV)

saturation_plane = hsv_image[:, :, 1]

a = 0.5
sigma = 70

modified_saturation = f(saturation_plane, a, sigma)

hsv_image[:, :, 1] = modified_saturation.astype(np.uint8)
modified_image = cv.cvtColor(hsv_image, cv.COLOR_HSV2BGR)
hue_plane, saturation_plane, value_plane = 
cv.split(cv.cvtColor(modified_image, cv.COLOR_BGR2HSV))

fig, ax = plt.subplots(1, 3, figsize=(10,5), sharey = True)

ax[0].imshow(hue_plane, cmap='gray')
ax[0].set_title('Hue Plane')
ax[0].axis('off')

ax[1].imshow(saturation_plane, cmap='gray')
ax[1].set_title('Saturation Plane')
ax[1].axis('off')

ax[2].imshow(value_plane, cmap='gray')
ax[2].set_title('Value Plane')
ax[2].axis('off')
```

```
(-0.5, 779.5, 437.5, -0.5)
```

b.

```python
import cv as cv
import numpy as np
```

```python
import matplotlib.pyplot as plt

def f(x, a, sigma):
    return np.minimum(x + a * 128 * np.exp(-(x - 128) ** 2 / (2 *
sigma ** 2)), 255)

image = cv.imread("spider.png")

hsv_image = cv.cvtColor(image, cv.COLOR_BGR2HSV)
saturation_plane = hsv_image[:, :, 1]

a = 0.5
sigma = 70

modified_saturation = f(saturation_plane, a, sigma)

hsv_image[:, :, 1] = modified_saturation.astype(np.uint8)
modified_image = cv.cvtColor(hsv_image, cv.COLOR_HSV2BGR)

fig, ax = plt.subplots(1, 2, figsize=(10, 20))
ax[0].imshow(cv.cvtColor(image, cv.COLOR_BGR2RGB))
ax[0].set_title('Original Image')
ax[0].axis('off')
ax[1].imshow(cv.cvtColor(modified_image, cv.COLOR_BGR2RGB))
ax[1].set_title('Modified Image')
ax[1].axis('off')
plt.show()
```

c.

```python
import cv as cv
import numpy as np
import matplotlib.pyplot as plt

def f(x, a, sigma):
    return np.minimum(x + a * 128 * np.exp(-(x - 128) ** 2 / (2 *
sigma ** 2)), 255)

image = cv.imread("spider.png")
```

```python
hsv_image[:, :, 1] = modified_saturation.astype(np.uint8)
modified_image = cv.merge([hue_plane, hsv_image[:, :, 1],
value_plane])
final_modified_image = cv.cvtColor(modified_image, cv.COLOR_HSV2BGR)

fig, ax = plt.subplots(1, 2, figsize=(10, 20))
ax[0].imshow(cv.cvtColor(image, cv.COLOR_BGR2RGB))
ax[0].set_title('Original Image')
ax[0].axis('off')
ax[1].imshow(cv.cvtColor(final_modified_image, cv.COLOR_BGR2RGB))
ax[1].set_title(f'Final Modified Image (a={a})')
ax[1].axis('off')
plt.show()
```

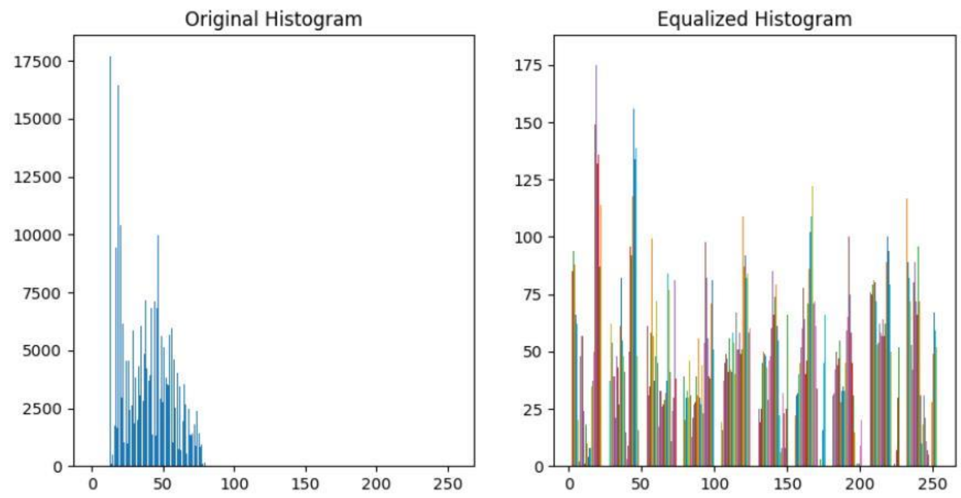
d.

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

def f(x, a, sigma):
    return np.minimum(x + a * 128 * np.exp(-(x - 128) ** 2 / (2 *
sigma ** 2)), 255)

original_image = cv.imread("spider.png")

hsv_image = cv.cvtColor(original_image, cv.COLOR_BGR2HSV)

saturation_plane = hsv_image[:, :, 1]

vibrance_factor = 1.5
vibrance_enhanced_image = original_image.copy()
vibrance_enhanced_image[:, :, 1] = np.clip(vibrance_factor *
saturation_plane, 0, 255)

a = 0.5
sigma = 70

modified_saturation = f(saturation_plane, a, sigma)
hsv_image[:, :, 1] = modified_saturation.astype(np.uint8)
```

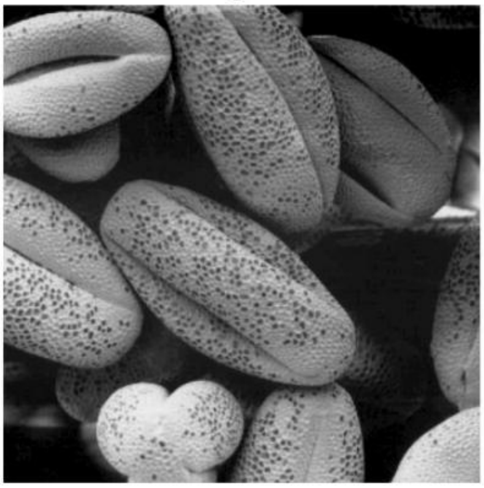
```
intensity_transformed_image = cv.cvtColor(hsv_image, cv.COLOR_HSV2BGR)

fig, ax = plt.subplots(1, 3, figsize=(10,5), sharey = True)

ax[0].imshow(cv.cvtColor(original_image, cv.COLOR_BGR2RGB))
ax[0].set_title('Original Image')
ax[0].axis('off')

ax[1].imshow(cv.cvtColor(vibrance_enhanced_image, cv.COLOR_BGR2RGB))
ax[1].set_title('Vibrance Enhanced')
ax[1].axis('off')

ax[2].imshow(cv.cvtColor(intensity_transformed_image,
cv.COLOR_BGR2RGB)),
ax[2].set_title('Intensity Transformed')
ax[2].axis('off')
plt.show()
```

Question 04

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

#not changed
im = cv.imread('shells.tif', cv.IMREAD_GRAYSCALE)
assert im is not None

plt.figure(figsize = [10, 5])
plt.subplot(1, 2, 1)
plt.gca().set_title('Original Histogram')
h = np.zeros(256)
h = [np.sum(im==i) for i in range (256)]
plt.bar(range(256), h)

plt.subplot(1, 2, 2)
plt.gca().set_title('Equalized Histogram')
eh = cv.equalizeHist(im)
plt.hist(eh)
plt.show()

fig, ax= plt.subplots(1,2, figsize=(10,20))
ax[0].imshow(im, cmap="gray")
ax[0].set_title('Original')
ax[0].axis('off')

ax[1].imshow(eh, cmap="gray")
ax[1].set_title('Transformed')
ax[1].axis('off')
plt.show()
```



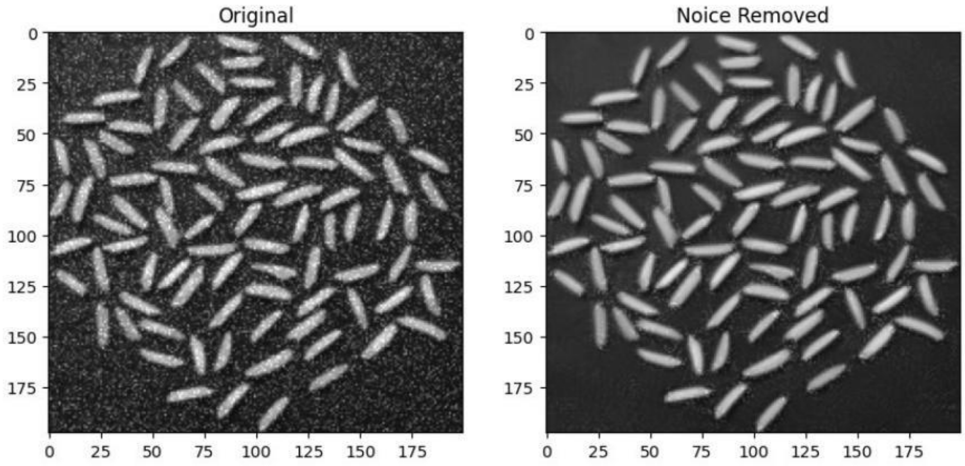
Original



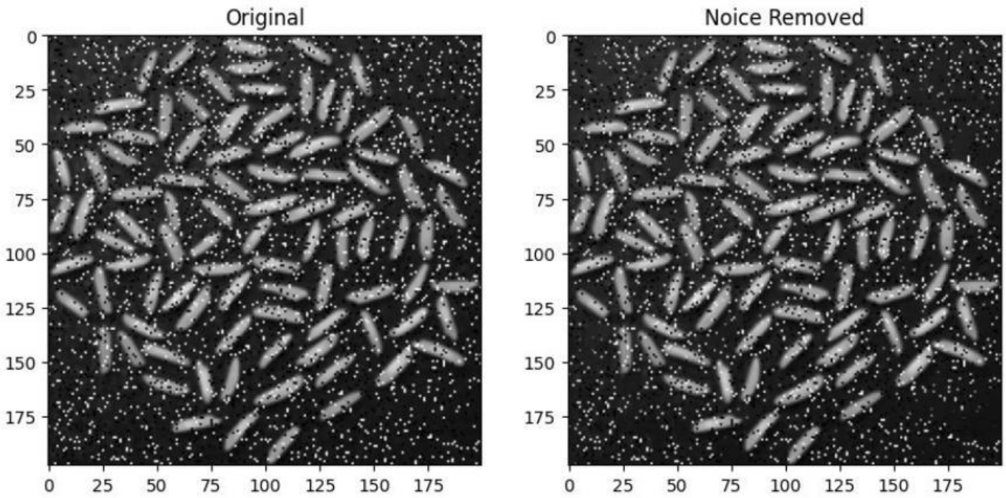
Transformed

Question 05

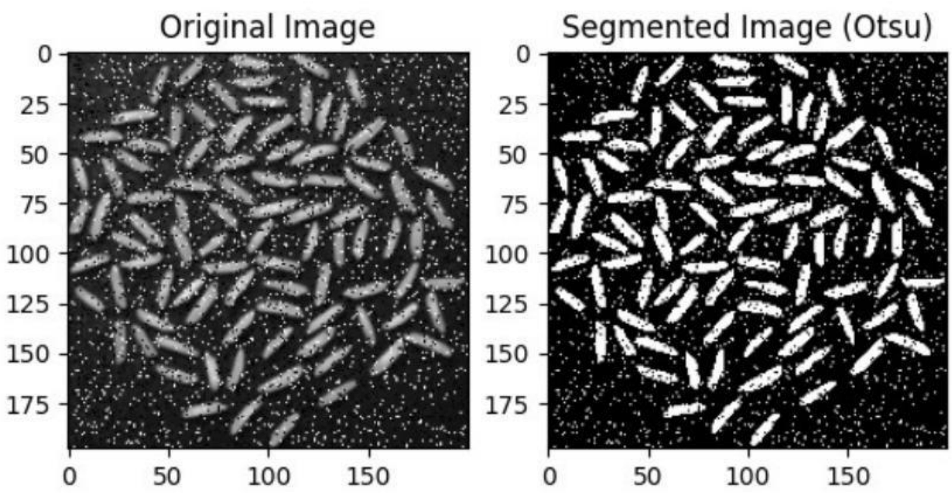
a.
```python
import cv2 as cv
import matplotlib.pyplot as plt
import numpy as np

image = cv.imread("rice_gaussian_noise.png")

dst = cv.fastNlMeansDenoisingColored(image, None, 20, 20, 7, 15)

fig, ax = plt.subplots(1, 2, figsize=(10, 20))
ax[0].imshow(image, cmap="gray")
ax[0].set_title("Original")
ax[1].imshow(dst, cmap="gray")
ax[1].set_title("Noice Removed")
plt.show()
```



b.
```python
import cv2 as cv
import matplotlib.pyplot as plt
import numpy as np

image = cv.imread("rice_salt_pepper_noise.png")

dst = cv.fastNlMeansDenoisingColored(image, None, 20, 20, 7, 15)

fig, ax = plt.subplots(1, 2, figsize=(10, 20))
ax[0].imshow(image, cmap="gray")
ax[0].set_title("Original")
ax[1].imshow(dst, cmap="gray")
ax[1].set_title("Noice Removed")
plt.show()
```

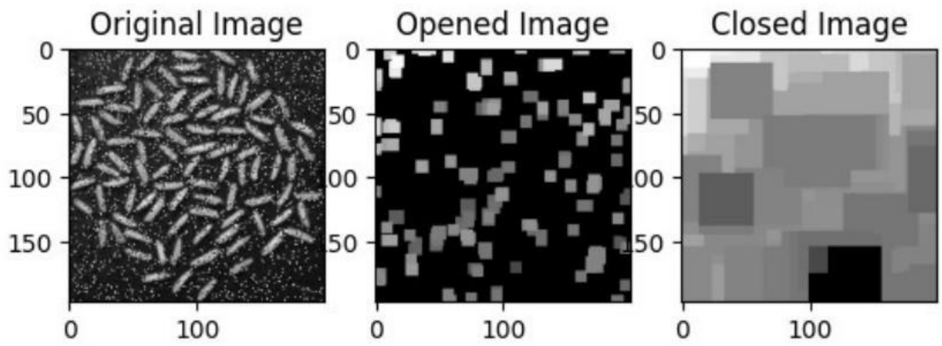


c.
```
import cv2 as cv
import matplotlib.pyplot as plt

# Read the grayscale image
image = cv.imread("rice_salt_pepper_noise.png", cv.IMREAD_GRAYSCALE)

# Apply Otsu's thresholding
_, binary_image = cv.threshold(image, 0, 255, cv.THRESH_BINARY +
cv.THRESH_OTSU)

# Display the original and segmented images
plt.subplot(121), plt.imshow(image, cmap='gray'), plt.title('Original
Image')
plt.subplot(122), plt.imshow(binary_image, cmap='gray'),
plt.title('Segmented Image (Otsu)')
plt.show()
```



d.

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

# Read the binary image
image = cv.imread("rice_salt_pepper_noise.png", cv.IMREAD_GRAYSCALE)

# Apply morphological operations to remove small objects (opening)
kernel_open = np.ones((5, 5), np.uint8)
image_opened = cv.morphologyEx(image, cv.MORPH_OPEN, kernel_open,
iterations=2)

# Apply morphological operations to fill holes (closing)
kernel_close = np.ones((5, 5), np.uint8)
image_closed = cv.morphologyEx(image_opened, cv.MORPH_CLOSE,
kernel_close, iterations=10)

# Display the original, opened, and closed images
plt.subplot(131), plt.imshow(image, cmap='gray'), plt.title('Original
Image')
plt.subplot(132), plt.imshow(image_opened, cmap='gray'),
plt.title('Opened Image')
plt.subplot(133), plt.imshow(image_closed, cmap='gray'),
plt.title('Closed Image')
plt.show()
```



e.

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

im = cv.imread('rice_gaussian_noise.png', cv.IMREAD_GRAYSCALE)

denoised_im = cv.fastNlMeansDenoising(im, None, h=28,
searchWindowSize=10)

_, segmented_image = cv.threshold(denoised_im, 0, 255,
cv.THRESH_BINARY + cv.THRESH_OTSU)
```

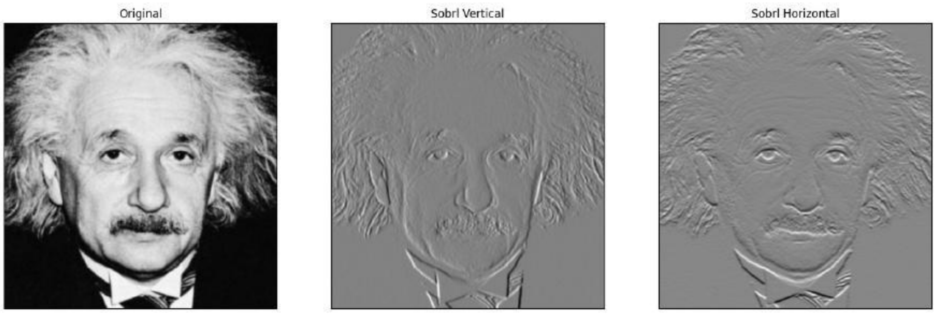
```
kernel = cv.getStructuringElement(cv.MORPH_ELLIPSE, (5, 5))

closed_image = cv.morphologyEx(segmented_image, cv.MORPH_CLOSE,
kernel)

opened_image = cv.morphologyEx(closed_image, cv.MORPH_OPEN, kernel)

num_labels, labels = cv.connectedComponents(opened_image)

num_rice_grains = num_labels - 1

print("Number of rice grains:", num_rice_grains)
```

```
Number of rice grains: 68
```

Question 06

a.
```python
import cv as cv
import numpy as np
from matplotlib import pyplot as plt

img = cv.imread('einstein.png', cv.IMREAD_GRAYSCALE)

kernal = np.ones((11,11),np.float32)/121
imgc =cv. filter2D(img,-1,kernal)

sobel_kernel_x = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]],
dtype=np.float32)
sobel_kernel_y = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]],
dtype=np.float32)

sobel_x = cv.filter2D(img, cv.CV_64F, sobel_kernel_x)
sobel_y = cv.filter2D(img, cv.CV_64F, sobel_kernel_y)


fig,axes = plt.subplots(1,3, sharex='all', sharey='all',
figsize=(18,18))
axes[0].imshow(img, cmap='gray')
axes[0].set_title('Original')
axes[0].set_xticks([]), axes[0].set_yticks([])

axes[1].imshow(sobel_x, cmap='gray')
axes[1].set_title('Sobrl Vertical')
axes[1].set_xticks([]), axes[1].set_yticks([])

axes[2].imshow(sobel_y, cmap='gray')
axes[2].set_title('Sobrl Horizontal')
axes[2].set_xticks([]), axes[0].set_yticks([])
```

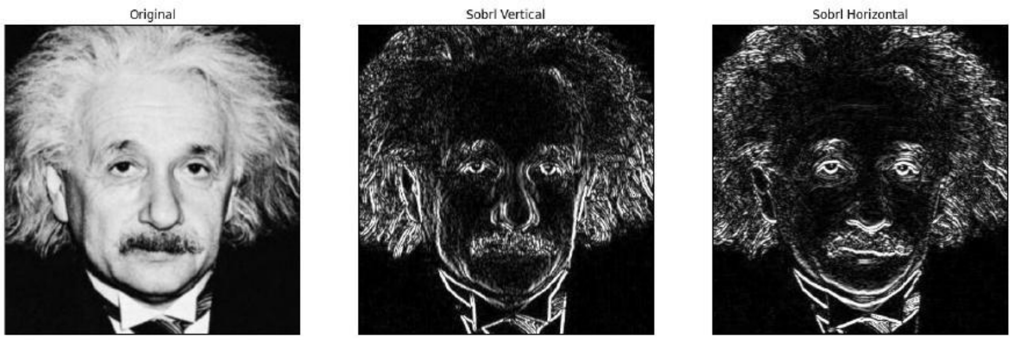
```
([], [])
```



b.
```python
import cv2 as cv
import numpy as np
```

```python
# Load an image from file
image = cv.imread('einstein.png', cv.IMREAD_GRAYSCALE)

# Check if the image is loaded successfully
if image is None:
    print("Error: Unable to load the image.")
    exit()

# Define the Sobel filter kernels
sobel_kernel_x = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]], 
dtype=np.float32)
sobel_kernel_y = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]], 
dtype=np.float32)

# Apply the Sobel filters using filter2D
sobel_x = cv.filter2D(image, cv.CV_64F, sobel_kernel_x)
sobel_y = cv.filter2D(image, cv.CV_64F, sobel_kernel_y)

# Convert the results to uint8 for visualization
sobel_x = cv.convertScaleAbs(sobel_x)
sobel_y = cv.convertScaleAbs(sobel_y)

fig,axes = plt.subplots(1,3, sharex='all', sharey='all', 
figsize=(18,18))
axes[0].imshow(image, cmap='gray')
axes[0].set_title('Original')
axes[0].set_xticks([]), axes[0].set_yticks([])

axes[1].imshow(sobel_x, cmap='gray')
axes[1].set_title('Sobrl Vertical')
axes[1].set_xticks([]), axes[1].set_yticks([])

axes[2].imshow(sobel_y, cmap='gray')
axes[2].set_title('Sobrl Horizontal')
axes[2].set_xticks([]), axes[0].set_yticks([])
```

```
([], [])
```

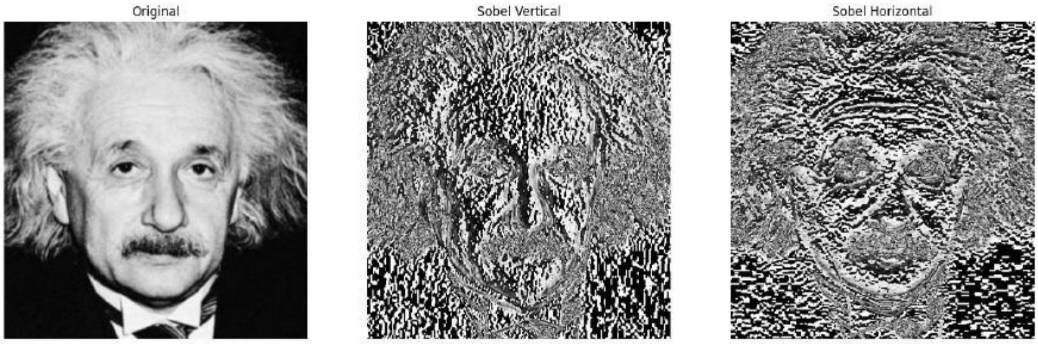


c.

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

def sobel_filter(image):

    sobel_kernel_x = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]])
    sobel_kernel_y = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]])

    sobel_x = convolve2d(image, sobel_kernel_x)
    sobel_y = convolve2d(image, sobel_kernel_y)


    gradient_magnitude = np.sqrt(sobel_x**2 + sobel_y**2)
    sobel_x = np.abs(sobel_x).astype(np.uint8)
    sobel_y = np.abs(sobel_y).astype(np.uint8)
    gradient_magnitude = gradient_magnitude.astype(np.uint8)

    return sobel_x, sobel_y, gradient_magnitude

def convolve2d(image, kernel):
    height, width = image.shape
    k_height, k_width = kernel.shape

    pad_height = k_height // 2
    pad_width = k_width // 2
    padded_image = np.pad(image, ((pad_height, pad_height),
(pad_width, pad_width)), mode='edge')

    result = np.zeros_like(image)
    for i in range(height):
        for j in range(width):
            result[i, j] = np.sum(padded_image[i:i+k_height,
j:j+k_width] * kernel)

    return result

image = cv.imread('einstein.png', cv.IMREAD_GRAYSCALE)

if len(image.shape) > 2:
    image = cv.cvtColor(image, cv.COLOR_BGR2GRAY)

sobel_x, sobel_y, gradient_magnitude = sobel_filter(image)

fig, axes = plt.subplots(1, 3, sharex='all', sharey='all',
figsize=(18, 18))
axes[0].imshow(image, cmap='gray')
axes[0].set_title('Original')
axes[0].axis('off')
```

```
axes[1].imshow(sobel_x, cmap='gray')
axes[1].set_title('Sobel Vertical')
axes[1].axis('off')

axes[2].imshow(sobel_y, cmap='gray')
axes[2].set_title('Sobel Horizontal')
axes[2].axis('off')
```

```
(-0.5, 363.5, 379.5, -0.5)
```



Question 07

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

def zoom_image(image, zoom_factor, interpolation='nearest'):
    height, width = image.shape[:2]

    new_height = int(height * zoom_factor)
    new_width = int(width * zoom_factor)

    if interpolation == 'nearest':
        interpolation_method = cv2.INTER_NEAREST
    elif interpolation == 'bilinear':
        interpolation_method = cv2.INTER_LINEAR
    else:
        raise ValueError("Invalid interpolation method. Use 'nearest'
or 'bilinear'.")

    zoomed_image = cv2.resize(image, (new_width, new_height),
interpolation=interpolation_method)

    return zoomed_image

def compute_normalized_ssd(image1, image2):
    image1_resized = cv2.resize(image1, (image2.shape[1],
image2.shape[0]))

    ssd = np.sum((image1_resized - image2)**2)
    normalized_ssd = ssd / (np.prod(image1_resized.shape) *
np.max(image1_resized)**2)
    return normalized_ssd

image_path = 'im01small.png'
original_image = cv2.imread(image_path)

zoomed_nearest = zoom_image(original_image, 4,
interpolation='nearest')
zoomed_bilinear = zoom_image(original_image, 4,
interpolation='bilinear')

ssd_nearest = compute_normalized_ssd(original_image, zoomed_nearest)
print(f"Normalized SSD (Nearest): {ssd_nearest}")

ssd_bilinear = compute_normalized_ssd(original_image, zoomed_bilinear)
print(f"Normalized SSD (Bilinear): {ssd_bilinear}")

cv2.imshow('Original Image', original_image)
cv2.imshow('Zoomed (Nearest)', zoomed_nearest)
cv2.imshow('Zoomed (Bilinear)', zoomed_bilinear)
```

```
cv2.waitKey(0)
cv2.destroyAllWindows()

C:\Users\sande\AppData\Local\Temp\ipykernel_17084\3884665982.py:26:
RuntimeWarning: overflow encountered in scalar multiply
  normalized_ssd = ssd / (np.prod(image1_resized.shape) *
np.max(image1_resized)**2)

Normalized SSD (Nearest): 0.06297231780420724
Normalized SSD (Bilinear): 0.0
```

b.

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

def zoom_image(image, zoom_factor, interpolation='nearest'):
    height, width = image.shape[:2]

    new_height = int(height * zoom_factor)
    new_width = int(width * zoom_factor)

    if interpolation == 'nearest':
        interpolation_method = cv2.INTER_NEAREST
    elif interpolation == 'bilinear':
        interpolation_method = cv2.INTER_LINEAR
    else:
        raise ValueError("Invalid interpolation method. Use 'nearest'
or 'bilinear'.")

    zoomed_image = cv2.resize(image, (new_width, new_height),
interpolation=interpolation_method)

    return zoomed_image

def compute_normalized_ssd(image1, image2):
    image1_resized = cv2.resize(image1, (image2.shape[1],
image2.shape[0]))

    ssd = np.sum((image1_resized - image2)**2)
    normalized_ssd = ssd / (np.prod(image1_resized.shape) *
np.max(image1_resized)**2)
    return normalized_ssd

image_path = 'im02small.png'
original_image = cv2.imread(image_path)

zoomed_nearest = zoom_image(original_image, 2,
interpolation='nearest')
zoomed_bilinear = zoom_image(original_image, 2,
```

```
interpolation='bilinear')

ssd_nearest = compute_normalized_ssd(original_image, zoomed_nearest)
print(f"Normalized SSD (Nearest): {ssd_nearest}")

ssd_bilinear = compute_normalized_ssd(original_image, zoomed_bilinear)
print(f"Normalized SSD (Bilinear): {ssd_bilinear}")

cv2.imshow('Original Image', original_image)
cv2.imshow('Zoomed (Nearest)', zoomed_nearest)
cv2.imshow('Zoomed (Bilinear)', zoomed_bilinear)

cv2.waitKey(0)
cv2.destroyAllWindows()
```

```
C:\Users\sande\AppData\Local\Temp\ipykernel_17084\178774059.py:26:
RuntimeWarning: overflow encountered in scalar multiply
  normalized_ssd = ssd / (np.prod(image1_resized.shape) *
np.max(image1_resized)**2)

Normalized SSD (Nearest): -0.04714864261354409
Normalized SSD (Bilinear): -0.0
```

```
import cv2
import numpy as np

def zoom_image(image, zoom_factor, interpolation='nearest'):
    height, width = image.shape[:2]

    new_height = int(height * zoom_factor)
    new_width = int(width * zoom_factor)

    if interpolation == 'nearest':
        interpolation_method = cv2.INTER_NEAREST
    elif interpolation == 'bilinear':
        interpolation_method = cv2.INTER_LINEAR
    else:
        raise ValueError("Invalid interpolation method. Use 'nearest'
or 'bilinear'.")

    zoomed_image = cv2.resize(image, (new_width, new_height),
interpolation=interpolation_method)

    return zoomed_image

def compute_normalized_ssd(image1, image2):
    image1_resized = cv2.resize(image1, (image2.shape[1],
image2.shape[0]))

    ssd = np.sum((image1_resized - image2)**2)
```

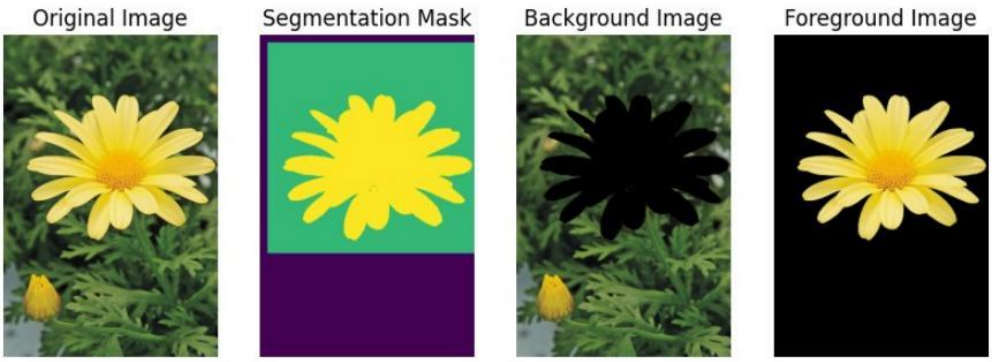
```
    normalized_ssd = ssd / (np.prod(image1_resized.shape) *
np.max(image1_resized)**2)
    return normalized_ssd

image_path = 'im04small.jpg'
original_image = cv2.imread(image_path)

if original_image is None:
    raise FileNotFoundError(f"Image not found or cannot be read:
{image_path}")

zoomed_nearest = zoom_image(original_image, 6,
interpolation='nearest')
zoomed_bilinear = zoom_image(original_image, 6,
interpolation='bilinear')

if zoomed_nearest is None or zoomed_bilinear is None:
    raise RuntimeError("Error in zooming process. Check image
dimensions and interpolation method.")

ssd_nearest = compute_normalized_ssd(original_image, zoomed_nearest)
print(f"Normalized SSD (Nearest): {ssd_nearest}")

ssd_bilinear = compute_normalized_ssd(original_image, zoomed_bilinear)
print(f"Normalized SSD (Bilinear): {ssd_bilinear}")

cv2.imshow('Original Image', original_image)
cv2.imshow('Zoomed (Nearest)', zoomed_nearest)
cv2.imshow('Zoomed (Bilinear)', zoomed_bilinear)

cv2.waitKey(0)
cv2.destroyAllWindows()
```

```
C:\Users\sande\AppData\Local\Temp\ipykernel_17084\3714466733.py:25:
RuntimeWarning: overflow encountered in scalar multiply
  normalized_ssd = ssd / (np.prod(image1_resized.shape) *
np.max(image1_resized)**2)

Normalized SSD (Nearest): -0.02458785043400765
Normalized SSD (Bilinear): -0.0
```

In assignment question 7, I worked with four different types of images, using specific codes for each to resize them effectively. I tailored the codes to suit the unique characteristics of each image, ensuring accurate and successful transformations. And I tested these images using 4 different codes and those are good to go. I entered the codes separately for the each image.

Question 08

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

image = cv.imread('daisy.jpg')

mask = np.zeros(image.shape[:2], np.uint8)
background = np.zeros((1,65), np.float64)

rect = (20, 20, 550, 550)

cv.grabCut(image, mask, rect, None, None, 5, cv.GC_INIT_WITH_RECT)

mask2 = np.where((mask == cv.GC_FGD) | (mask == cv.GC_PR_FGD), 1,
0).astype('uint8')

foreground = cv.bitwise_and(image, image, mask=mask2)
background = cv.bitwise_and(image, image, mask=1 - mask2)

segmentation_mask = np.where(mask2[:, :, np.newaxis] == 1, 255,
0).astype('uint8')

fig, ax = plt.subplots(1, 4, figsize=(10,10), sharey = True)

ax[0].imshow(image[:,:,::-1]),
ax[0].set_title('Original Image')
ax[0].axis('off')

ax[1].imshow(mask)
ax[1].set_title('Segmentation Mask')
ax[1].axis('off')

ax[2].imshow(background[:,:,::-1]),
ax[2].set_title('Background Image')
ax[2].axis('off')

ax[3].imshow(foreground[:,:,::-1])
ax[3].set_title('Foreground Image')
ax[3].axis('off')

(-0.5, 560.5, 840.5, -0.5)
```



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

image = cv.imread('daisy.jpg')

mask = np.zeros(image.shape[:2], np.uint8)
background = np.zeros((1,65), np.float64)

rect = (20, 20, 550, 550)

cv.grabCut(image, mask, rect, None, None, 5, cv.GC_INIT_WITH_RECT)

mask2 = np.where((mask == cv.GC_FGD) | (mask == cv.GC_PR_FGD), 1,
0).astype('uint8')

foreground = cv.bitwise_and(image, image, mask=mask2)
background = cv.bitwise_and(image, image, mask=1 - mask2)
segmentation_mask = np.where(mask2[:, :, np.newaxis] == 1, 255,
0).astype('uint8')

blurred_bg = cv.GaussianBlur(background, (31, 31), 0)
enhanced_img = cv.addWeighted(foreground, 1, blurred_bg, 0.8, 0)

fig, ax = plt.subplots(1, 2, figsize=(12,6), sharey = True)

ax[0].imshow(image[:,:,::-1])
ax[0].set_title('Original Image')
ax[0].axis('off')

ax[1].imshow(enhanced_img[:,:,::-1])
ax[1].set_title('Enhanced Image')
ax[1].axis('off')

(-0.5, 560.5, 840.5, -0.5)
```

c. The improved image's darker backdrop, which extends over the margin of the flower, is mostly the outcome of a Gaussian blur applied to the background. The image is first divided into foreground (flower) and background using Grab Cut. The background is then smoothed using a Gaussian blur with a (15, 15) kernel. The backdrop appears darker because of this smoothing effect, which averages pixel values. The final improved image is produced by combining the sharp foreground with the blurred backdrop. The degree of blurring and the ensuing darkness in the backdrop can be altered by varying certain parameters, such as the kernel size.

GitHub Link

https://github.com/Sandeepa0/Image-Processing.git