Step 1: Install OpenCV

```
!pip install opencv-python-headless
```

```
Requirement already satisfied: opencv-python-headless in /usr/local/lib/python3.
Requirement already satisfied: numpy>=1.21.2 in /usr/local/lib/python3.10/dist-p
```

Step 2: Import Necessary Libraries

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

# Function to display an image using matplotlib
def display_image(img, title="Image"):
  plt.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
  plt.title(title)
  plt.axis('off')
  plt.show()

# Function to display two images side by side
def display_images(img1, img2, title1="Image 1", title2="Image 2"):
  plt.subplot(1, 2, 1)
  plt.imshow(cv2.cvtColor(img1, cv2.COLOR_BGR2RGB))
  plt.title(title1)
  plt.axis('off')
  plt.subplot(1, 2, 2)
  plt.imshow(cv2.cvtColor(img2, cv2.COLOR_BGR2RGB))
  plt.title(title2)
  plt.axis('off')
  plt.show()
```

Step 3: Load an Image

```
from google.colab import files
from io import BytesIO
from PIL import Image

uploaded = files.upload()
```

```
# Convert to OpenCV format
image_path = next(iter(uploaded)) # Get the image file name image = Image.open(
image = Image.open(BytesIO(uploaded[image_path]))
image = cv2.cvtColor(np.array(image), cv2.COLOR_RGB2BGR)
```

Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

Saving joseppogi.jpeg to joseppogi.jpeg

Exercise 1: Scaling and Rotation

```
# Scaling
def scale_image(img, scale_factor):
    height, width = img.shape[:2] # This line and the following should be inder
    scaled_img = cv2.resize(img,
    (int(width * scale_factor), int(height * scale_factor)), interpolation=cv2.
    return scaled_img

# Rotate
def rotate_image(img, angle):
    height, width = img.shape[:2]
    center = (width // 2, height // 2)
    matrix = cv2.getRotationMatrix2D(center, angle, 1.0)
    rotated_img = cv2.warpAffine(img, matrix, (width, height))
    return rotated_img

# Scale image by 0.5
scaled_image = scale_image(image, 0.5)
display_image(scaled_image, "Scaled Image (50%)")
# Rotate image by 45 degrees
rotated_image = rotate_image(image, 45)
display_image(rotated_image, "Rotated Image (45°)")
```

Scaled Image (50%)

Rotated Image (45°)

Exercise 2: Blurring Techniques

```
# Gaussian Blur
gaussian_blur = cv2.GaussianBlur(image, (5, 5), 0)
display_image(gaussian_blur, "Gaussian Blur (5x5)")

# Median Blur
median_blur = cv2.medianBlur(image, 5)
display_image(median_blur, "Median Blur (5x5)")
```

Exercise 3: Edge Detection using Canny

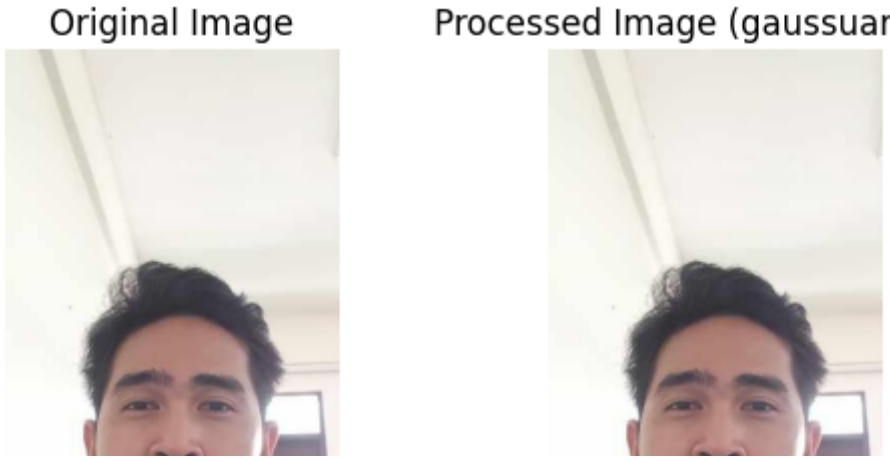
```
# Canny Edge Detection
edges = cv2.Canny(image, 100, 200)
display_image(edges, "Canny Edge Detection (100, 200)")
```

Exercise 4: Basic Image Processor (Interactive)

```
def process_image(img, action):
  if action == 'scale':
      return scale_image(img, 0.5)
  elif action == 'rotate':
      return rotate_image(img, 45)
  elif action == 'gaussian_blur':
      return cv2.GaussianBlur(img, (5, 5), 0)
  elif action == 'median_blur':
      return cv2.medianBlur(img, 5)
  elif action == 'canny':
      return cv2.Canny(img, 100, 200)
  else:
      return img

action = input("Enter action (scale, rotate, gaussian_blur, median_blur, canny)
processed_image = process_image(image, action)
display_images(image, processed_image, "Original Image", f"Processed Image ({ac
```

```
Enter action (scale, rotate, gaussian_blur, median_blur, canny): gaussuan_blur
```



Exercise 5: Comparison of Filtering Techniques

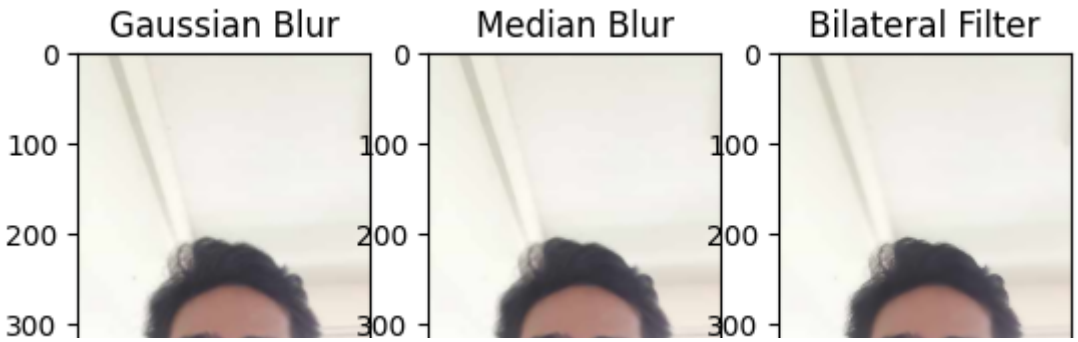
```
# Applying Gaussian, Median, and Bilateral filters
gaussian_blur = cv2.GaussianBlur(image, (5, 5), 0)
median_blur = cv2.medianBlur(image, 5)
bilateral_filter = cv2.bilateralFilter(image, 9, 75, 75)

# Display the results for comparison plt.figure(figsize=(10, 5))
plt.subplot(1, 3, 1)
plt.imshow(cv2.cvtColor(gaussian_blur, cv2.COLOR_BGR2RGB))
plt.title("Gaussian Blur")

plt.subplot(1, 3, 2)
plt.imshow(cv2.cvtColor(median_blur, cv2.COLOR_BGR2RGB))
plt.title("Median Blur")

plt.subplot(1, 3, 3)
plt.imshow(cv2.cvtColor(bilateral_filter, cv2.COLOR_BGR2RGB))
plt.title("Bilateral Filter")

plt.show()
```




```
# Sobel Edge Detection
def sobel_edge_detection(img):
    # Convert to grayscale
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

    # Sobel edge detection in the x direction
    sobelx = cv2.Sobel(gray, cv2.CV_64F, 1, 0, ksize=5)

    # Sobel edge detection in the y direction
    sobely = cv2.Sobel(gray, cv2.CV_64F, 0, 1, ksize=5)

    # Combine the two gradients
    sobel_combined = cv2.magnitude(sobelx, sobely)

    return sobel_combined

# Apply Sobel edge detection to the uploaded image
sobel_edges = sobel_edge_detection(image)
plt.imshow(sobel_edges, cmap='gray')
plt.title("Sobel Edge Detection")
plt.axis('off')
plt.show()
```


```
# Prewitt Edge Detection
def prewitt_edge_detection(img):
    # Convert to grayscale
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

    # Prewitt operator kernels for x and y directions
    kernelx = np.array([[1, 0, -1], [1, 0, -1], [1, 0, -1]], dtype=int)
    kernely = np.array([[1, 1, 1], [0, 0, 0], [-1, -1, -1]], dtype=int)

    # Applying the Prewitt operator
    prewittx = cv2.filter2D(gray, cv2.CV_64F, kernelx)
    prewitty = cv2.filter2D(gray, cv2.CV_64F, kernely)

    # Combine the x and y gradients by converting to floating point
    prewitt_combined = cv2.magnitude(prewittx, prewitty)

    return prewitt_combined

# Apply Prewitt edge detection to the uploaded image
prewitt_edges = prewitt_edge_detection(image)
plt.imshow(prewitt_edges, cmap='gray')
plt.title("Prewitt Edge Detection")
plt.axis('off')
plt.show()
```

Prewitt Edge Detection

```
# prompt: output all images in one plot

import matplotlib.pyplot as plt
# Applying Gaussian, Median, and Bilateral filters
gaussian_blur = cv2.GaussianBlur(image, (5, 5), 0)
median_blur = cv2.medianBlur(image, 5)
bilateral_filter = cv2.bilateralFilter(image, 9, 75, 75)

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

plt.subplot(1, 4, 1)
plt.imshow(cv2.cvtColor(image, cv2.COLOR_BGR2RGB))
plt.title("Original Image")
plt.axis('off')

plt.subplot(1, 4, 2)
plt.imshow(cv2.cvtColor(gaussian_blur, cv2.COLOR_BGR2RGB))
plt.title("Gaussian Blur")
plt.axis('off')

plt.subplot(1, 4, 3)
plt.imshow(cv2.cvtColor(median_blur, cv2.COLOR_BGR2RGB))
plt.title("Median Blur")
plt.axis('off')

plt.subplot(1, 4, 4)
plt.imshow(cv2.cvtColor(bilateral_filter, cv2.COLOR_BGR2RGB))
plt.title("Bilateral Filter")
plt.axis('off')

plt.show()
```


```
# Bilateral Filter
def bilateral_blur(img):
    bilateral = cv2.bilateralFilter(img, 9, 75, 75)
    return bilateral
# Apply Bilateral filter to the uploaded image
bilateral_blurred = bilateral_blur(image)
plt.imshow(cv2.cvtColor(bilateral_blurred, cv2.COLOR_BGR2RGB))
plt.title("Bilateral Filter")
plt.axis('off')
plt.show()
```


```
# Laplacian Edge Detection
def laplacian_edge_detection(img):
    # Convert to grayscale
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
```

```
    # Apply Laplacian operator
    laplacian = cv2.Laplacian(gray, cv2.CV_64F)
    return laplacian

# Apply Laplacian edge detection to the uploaded image
laplacian_edges = laplacian_edge_detection(image)
plt.imshow(laplacian_edges, cmap='gray')
plt.title("Laplacian Edge Detection")
plt.axis('off')
plt.show()
```

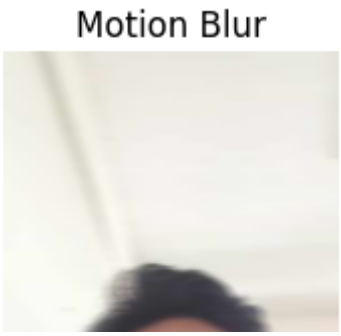

```
# Box Filter
def box_blur(img):
    box = cv2.boxFilter(img, -1, (5, 5))
    return box

# Apply Box filter to the uploaded image
box_blurred = box_blur(image)
plt.imshow(cv2.cvtColor(box_blurred, cv2.COLOR_BGR2RGB))
plt.title("Box Filter")
plt.axis('off')
plt.show()
```


```
# Motion Blur
def motion_blur(img):
    # Create motion blur kernel (size 15x15)
    kernel_size = 15
    kernel = np.zeros((kernel_size, kernel_size))
    kernel[int((kernel_size - 1) / 2), :] = np.ones(kernel_size)
    kernel = kernel / kernel_size

    # Apply motion blur
    motion_blurred = cv2.filter2D(img, -1, kernel)
    return motion_blurred

# Apply Motion blur to the uploaded image
motion_blurred = motion_blur(image)
plt.imshow(cv2.cvtColor(motion_blurred, cv2.COLOR_BGR2RGB))
plt.title("Motion Blur")
plt.axis('off')
plt.show()
```




```
# Unsharp Masking (Sharpening)
def unsharp_mask(img):
    # Create a Gaussian blur version of the image
    blurred = cv2.GaussianBlur(img, (9, 9), 10.0)
    # Sharpen by adding the difference between the original and the blurred ima
    sharpened = cv2.addWeighted(img, 1.5, blurred, -0.5, 0)
    return sharpened

# Apply Unsharp Masking to the uploaded image
sharpened_image = unsharp_mask(image)
plt.imshow(cv2.cvtColor(sharpened_image, cv2.COLOR_BGR2RGB))
plt.title("Unsharp Mask (Sharpening)")
plt.axis('off')
plt.show()
```


```
# Update process_image function to include new blurring techniques
def process_image(img, action):
```

```
    if action == 'scale':
        return scale_image(img, 0.5)
    elif action == 'rotate':
        return rotate_image(img, 45)
    elif action == 'gaussian_blur':
        return cv2.GaussianBlur(img, (5, 5), 0)
    elif action == 'median_blur':
        return cv2.medianBlur(img, 5)
    elif action == 'canny':
        return cv2.Canny(img, 100, 200)
    elif action == 'sobel':
        return sobel_edge_detection(img)
    elif action == 'laplacian':
        return laplacian_edge_detection(img)
    elif action == 'prewitt':
        return prewitt_edge_detection(img)
    elif action == 'bilateral_blur':
        return bilateral_blur(img)
    elif action == 'box_blur':
        return box_blur(img)
    elif action == 'motion_blur':
        return motion_blur(img)
    elif action == 'unsharp_mask':
        return unsharp_mask(img)
    else:
        return img


# Add new blurring options for interactive processing
action = input("Enter action (scale, rotate, gaussian_blur, median_blur, canny,
processed_image = process_image(image, action)
display_images(image, processed_image, "Original Image", f"Processed Image ({ac
```

```
Enter action (scale, rotate, gaussian_blur, median_blur, canny, sobel, laplacian
```

Generate | output all images in 4 columns, total of 13 images | Close

1 of 1 | Undo Changes | Use code with caution

```
# prompt: output all images in 4 columns, total of 13 images

import matplotlib.pyplot as plt
# Applying different image processing techniques
gaussian_blur = cv2.GaussianBlur(image, (5, 5), 0)
median_blur = cv2.medianBlur(image, 5)
bilateral_filter = cv2.bilateralFilter(image, 9, 75, 75)
sobel_edges = sobel_edge_detection(image)
laplacian_edges = laplacian_edge_detection(image)
prewitt_edges = prewitt_edge_detection(image)
box_blurred = box_blur(image)
motion_blurred = motion_blur(image)
sharpened_image = unsharp_mask(image)
scaled_image = scale_image(image, 0.5)
rotated_image = rotate_image(image, 45)
canny_edges = cv2.Canny(image, 100, 200)

# Display the results in 4 columns
plt.figure(figsize=(20, 15))

plt.subplot(4, 4, 1)
plt.imshow(cv2.cvtColor(image, cv2.COLOR_BGR2RGB))
plt.title("Original Image")
plt.axis('off')

plt.subplot(4, 4, 2)
plt.imshow(cv2.cvtColor(gaussian_blur, cv2.COLOR_BGR2RGB))
plt.title("Gaussian Blur")
plt.axis('off')

plt.subplot(4, 4, 3)
plt.imshow(cv2.cvtColor(median_blur, cv2.COLOR_BGR2RGB))
plt.title("Median Blur")
plt.axis('off')

plt.subplot(4, 4, 4)
plt.imshow(cv2.cvtColor(bilateral_filter, cv2.COLOR_BGR2RGB))
plt.title("Bilateral Filter")
```

```
plt.axis('off')

plt.subplot(4, 4, 5)
plt.imshow(sobel_edges, cmap='gray')
plt.title("Sobel Edge Detection")
plt.axis('off')

plt.subplot(4, 4, 6)
plt.imshow(laplacian_edges, cmap='gray')
plt.title("Laplacian Edge Detection")
plt.axis('off')

plt.subplot(4, 4, 7)
plt.imshow(prewitt_edges, cmap='gray')
plt.title("Prewitt Edge Detection")
plt.axis('off')

plt.subplot(4, 4, 8)
plt.imshow(cv2.cvtColor(box_blurred, cv2.COLOR_BGR2RGB))
plt.title("Box Filter")
plt.axis('off')

plt.subplot(4, 4, 9)
plt.imshow(cv2.cvtColor(motion_blurred, cv2.COLOR_BGR2RGB))
plt.title("Motion Blur")
plt.axis('off')

plt.subplot(4, 4, 10)
plt.imshow(cv2.cvtColor(sharpened_image, cv2.COLOR_BGR2RGB))
plt.title("Unsharp Masking")
plt.axis('off')

plt.subplot(4, 4, 11)
plt.imshow(cv2.cvtColor(scaled_image, cv2.COLOR_BGR2RGB))
plt.title("Scaled Image")
plt.axis('off')

plt.subplot(4, 4, 12)
plt.imshow(cv2.cvtColor(rotated_image, cv2.COLOR_BGR2RGB))
plt.title("Rotated Image")
plt.axis('off')

plt.subplot(4, 4, 13)
plt.imshow(cv2.cvtColor(canny_edges, cv2.COLOR_BGR2RGB))
plt.title("Canny Edge Detection")
plt.axis('off')

plt.show()
```

Original Image

Gaussian Blur

Median Blur

Bilateral Filter

Sobel Edge Detection

Laplacian Edge Detection

Prewitt Edge Detection

Box Filter

Start coding or generate with AI.

Motion Blur

Unsharp Masking

Scaled Image

Rotated Image

Canny Edge Detection